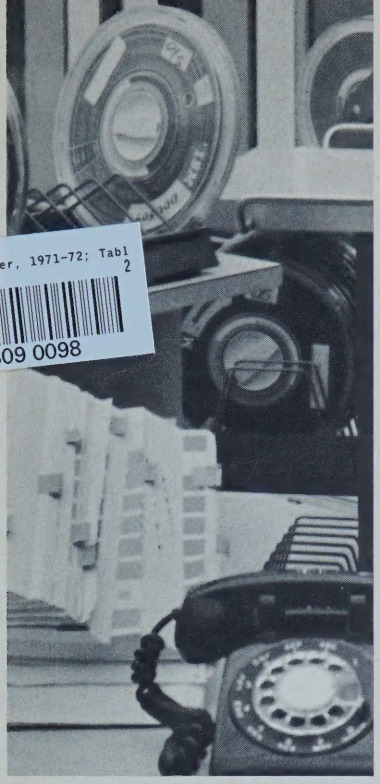
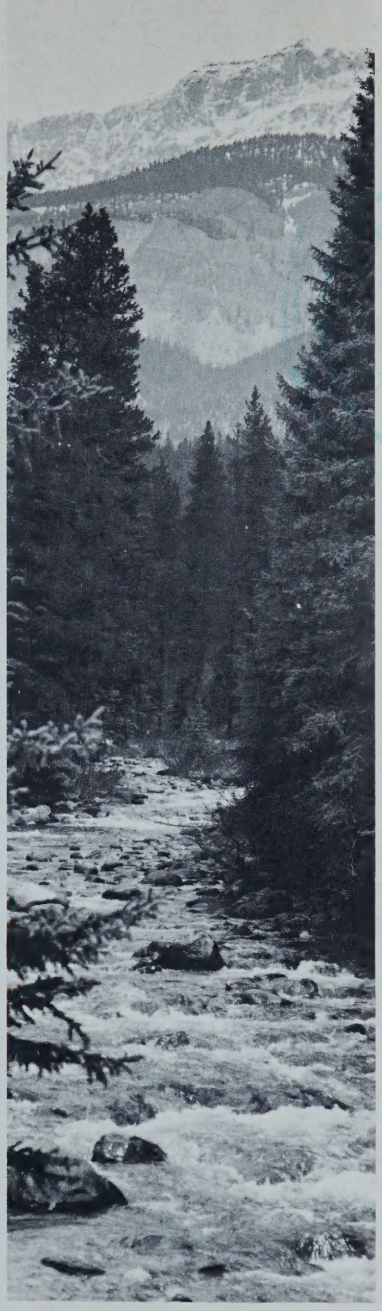
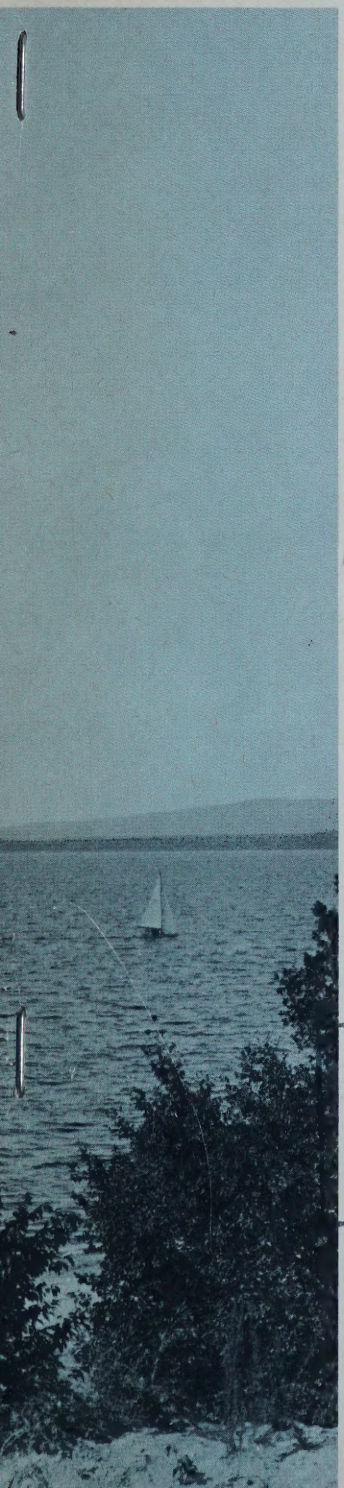
CA2 ALEN 15
72 W16
c. 2

CA2 ALEN 15 1972W16
Water Quality - Bow River, 1971-72; Tabl
ed March 28, 1973. 2
3 3398 00309 0098





C.2
EDMONTON



alberta
department
of the
environment

HON. W. J. YURKO, MINISTER

DR. E. E. BALLANTYNE, DEPUTY MINISTER

LIBRARY
VAULT 19

SESSIONAL PAPER 523.

WATER QUALITY
BOW RIVER
1971 - 1972

TABLED MARCH 28/73.

POLLUTION CONTROL
DIVISION

Digitized by the Internet Archive
in 2025 with funding from
Legislative Assembly of Alberta - Alberta Legislature Library

SESSIONAL PAPER 523.

WATER QUALITY
BOW RIVER

1971 - 1972

TABLED MARCH 27/73.

WATER QUALITY

BOW RIVER

1971 - 1972

by

P. ULLMAN, P. Eng.

PROVINCE OF ALBERTA
DEPARTMENT OF THE ENVIRONMENT
DIVISION OF POLLUTION CONTROL
6th Floor, Milner Building, Edmonton
AUGUST 23, 1972

Digitized by the Internet Archive
in 2025 with funding from
Legislative Assembly of Alberta - Alberta Legislature Library

https://archive.org/details/ableg_33398003090098

ABSTRACT

Four sampling surveys of the Bow River were conducted during the months of November through February for the winter of 1971-72. Analyses of industrial and municipal discharges were also co-ordinated with the water quality surveys of the Bow River.

The flow rate frequency distribution of the Bow River during the 1971-72 water year is slightly less than the distribution of flow rates during the past sixteen years. The biochemical oxygen demand constituents increased over last year, but were down substantially from the previous surveys. Phenolic loadings decreased from the previous years' sampling. Dissolved oxygen, threshold odor number, oil and grease and bacteriological constituents were satisfactory. Occasional high values of zinc, selenium and manganese were recorded. Mercury levels were high and the cause is to be further investigated.

TABLE OF CONTENTS

	Page
ABSTRACT	i
TABLE OF CONTENTS	ii
ESTABLISHMENT AND OPERATION OF THE PROGRAM	iii
INTRODUCTION	1
DISCUSSION	2
Monitoring Program	2
Hydrometric Data	3
Pollutant Loadings to the Bow River	4
Dissolved Oxygen	5
Biochemical Oxygen Demand	6
Nutrients	6
Threshold Odor Number	8
Oil and Grease	8
Phenolics	8
Heavy Metals	9
Bacteriological Constituents	11
SUMMARY	11

ESTABLISHMENT AND OPERATION OF THE PROGRAM

Many of the problems involved in the establishment and operation of the program are of practical rather than technical consideration. A summary discussion of some of the more basic considerations has been included.

PROGRAM OBJECTIVES

This program was established a number of years ago to provide basic information which would reveal pollution trends and provide water quality data for the many existing and prospective users of surface water in Alberta.

The monitoring program has these specific objectives:

1. To determine chemical, physical, bacteriological and biological characteristics of Alberta's water under changing conditions.
2. To indicate, when possible, the sources of pollution entering a stream.
3. To compile data for future pollution abatement activities.
4. To determine background data on certain types of wastes, and to detect critical changes.
5. To obtain data useful for municipal, industrial, agricultural and recreational uses.
6. To procure data useful and necessary for securing public action toward the preservation of streams for all beneficial uses.

SCOPE OF ANALYSES

The frequency of sampling is admittedly limited. In some instances a more important parameter such as dissolved oxygen is monitored continuously. The routine analyses shown in this report represent the minimum of bacteriological, biochemical and chemical analyses which justify the program.

SAMPLING STATIONS AND PROCEDURES

The following criteria were used as a basis for selection of the monitor stations:

1. Waters used for municipal, industrial, agricultural, and recreational purposes.

2. Near known or suspected sources of pollution.

3. Near the Alberta-Saskatchewan border to determine the quality of water leaving the province.

Stations were established at bridges whenever practical for convenient access to each watercourse. Routine samples included two litres for general chemical analyses, one litre each for phenolics and oil and grease, and 100 millilitres in a sterile bottle for bacteriological analyses. Four litre samples were collected in a pyrex glass jar for heavy metals analyses.

INTRODUCTION

Beneficial use of water from the Bow River basin historically originates with the hydro-electric power developments west of Calgary and the requirements by the irrigation districts east of Calgary. The Bow River is used in large quantities by local industry for cooling purposes, process work and as a source of drinking water supply for the municipalities of Cochrane and Bassano. The Glenmore Reservoir, containing water from the Elbow River basin, supplies the City of Calgary with drinking water.

The Bow River plays a vital part as a channel for the reception and removal of various liquid wastes such as treated sewage effluents and effluents from industrial processes. In general, such wastes should receive the best practicable and reasonably available pre-treatment to prevent overloading the river and destroying its self-purifying capacity. In certain instances, industries and municipalities are required to improve existing procedures and waste water treatment installations according to local conditions or as a result of anticipated growth and uses of water in the Bow River basin. Water quality monitoring of the Bow River was established several years ago to provide information which would reveal pollution trends and provide water quality data for the many existing and prospective users.

DISCUSSION

Monitoring Program

The major discharges of treated industrial and municipal liquid wastes to the Bow River occur in the Calgary area. Water quality studies of the Bow River upstream and downstream of these sources were coordinated with analyses of industrial discharges during four surveys from the period November 23, 1971 to February 10, 1972. Samples were also collected on the Sheep River, which is a tributary of the Bow.

The following locations were used as points of reference for the collection of the monthly samples along the Bow River (Figure 1):

1. Cushing Bridge - Calgary
2. Stier's Ranch
3. Highway Number 2 Bridge near Carseland
4. Bridge south of Cluny
5. Sheep River, Highway Number 2 Bridge

Hydrometric Data

Hydrological data of special significance in connection with water quality surveys is the determination of the river flow in cubic feet per second (c.f.s.). Flow rates in the Bow River at Calgary were recorded at Station No. 5 BH-4, about one-half mile above the confluence with the Elbow River. The flow rate at this station is affected by regulation at upstream power plants operated by Calgary Power Limited. The drainage area of this station includes 3,140 square miles and represents an annual average of 72% of the natural flow of the Bow River. The flow from the Elbow, Little Elbow, Sheep, Highwood Rivers and Nose and Fish Creeks include drainage from 3,440 square miles. These tributaries contribute to an annual average of 28% of the natural flow of the Bow River.

A graphical representation of the mean daily flows at Station No. 5 BH-4 for the period October 1, 1970 to March 31, 1971 is depicted in Appendix A-1. The maximum flow rate of 3,360 c.f.s. occurred on October 21, 1971 and the minimum critical flow of 1,200 c.f.s. occurred on February 20, 1972.

A statistical evaluation of flow rates over a period of 15 years is also present in Appendix A-2. This type of representation of flow data has the advantage that it does not change appreciably from year to year, whereas the average daily flow for a specific year will be quite variable. The statistical representation is considered to be a more scientific basis from calculating dilution factors and standards for industrial and municipal waste discharges. Design calculations are based on the critical flow rate corresponding to the 1% frequency of occurrence of that minimum flow which occurs during 3 days of a 365 day water year (April to March).

During the 1971-1972 water year, 1% of the time the flow was 1,200 c.f.s. as compared to 1,120 c.f.s. for the 16 year period. Due to the good regulation of flow in the Bow River, river discharge during the past year was very similar to flows observed during the 16 year average.

Pollutant Loadings to the Bow River

The Bow River receives waste water from five gas plants, three Calgary sewage treatment plants, two fertilizer manufacturing operations, two refineries and domestic waste from a number of smaller communities (Figure 1). These discharges are the major effluents directed to the Bow River and the total loadings of various pollutants for each survey are tabulated in Appendix A-5. A complete list of the waste water discharges, their control equipment and water users for the Bow River basin are listed in Appendices A-3 and A-4. The maximum biological oxygen demand load of 39,500 lbs./day to the Bow River occurred on November 23-24, 1971.

During the sampling year the following results are obtained:

1. The average biological oxygen demand loading was 24,750 lbs./day, up over last year, but down substantially from the two years previous.

2. An average of 7,340 lbs./day total phosphorous, down slightly from the previous year.

3. The average oil and grease loading was 8,405 lbs./day up over twice last year's value, but down substantially from the two previous years.

4. An average 15,060 lbs./day ammonia-nitrogen. This loading is up from last year's survey and also from the two previous years.

5. The average phenolic loading was 18 lbs./day down from the previous three surveys.

Dissolved Oxygen

Self-purification of the Bow River is dependent on biochemical reactions brought about by the activities of micro-organisms which, given sufficient dissolved oxygen, utilize the organic matter as food and break down compounds to simpler and comparatively harmless end products. Determinations of dissolved oxygen concentrations at various points in the Bow River were necessary to assess the extent to which self-purification had proceeded.

A dissolved oxygen concentration of 5 mg./l has been established as the standard level required to sustain fish. This standard represents a saturation level of 38% at a temperature of 0 degrees Centigrade and prevailing barometric pressures in Southern Alberta. Values of dissolved oxygen concentrations at Cushing Bridge, considered to be upstream of the major sources of effluent, exceeded 94% saturation (12.7 mg./l).

The dissolved oxygen concentration below the Cushing Bridge location indicates some de-oxygenation of the Bow River. The measured values this year are very similar to the oxygen value obtained in last year's survey. The dissolved oxygen concentrations were well above the water quality criteria. The minimum saturation level at Stier's Ranch was 75% (10.1 mg./l on January 25, 1972), at Carseland 66% (8.9 mg./l on February 9, 1972) and at Cluny 67% (9.0 mg./l on February 9, 1972). The minimum saturation level on the Sheep River before it joined the Bow was 81% (11.0 mg./l on January 25, 1972). Maximum, median and minimum values for the 1971-1972 winter are depicted in Appendix A-6.

Biochemical Oxygen Demand

The maximum biochemical oxygen demand concentration of 1.8 mg./l on March 2, 1971 at Cushing Bridge indicated very little organic pollution at this site. This level is indicative of natural occurring conditions. Increases in biochemical oxygen demand were evident at the downstream sites with a maximum occurring at Stier's Ranch, of 5.1 mg./l on December 7, 1971.

The average concentration at Stier's Ranch was 4.0 mg./l. Maximum values of 3.3 mg./l on February 9, 1972 and 1.3 mg./l on November 24, 1972 were observed at Carseland and Cluny respectively. The Sheep River maximum biochemical oxygen demand value of 2.1 mg./l was observed on November 24, 1972. These maximum values continue the reducing trends for biochemical oxygen demand that have been noted in the last few years, particularly since the beginning of the operation of Calgary's secondary treatment facility.

The maximum, median and minimum 1971-1972 biochemical oxygen demand values are plotted in Appendix A-7.

Nutrients

The presence of external sources of nutrients in the Bow River tends to increase the fertility of the river and troublesome algae growths may occur. Three nutrient groups are summarized below.

Ammonia-Nitrogen

Ammonia-nitrogen values ranged from a low of less than 0.1 mg./l (Cushing Bridge, January 25, 1972) to a high of 2.1 mg./l (Stier's Ranch, December 7, 1972). The average ammonia-nitrogen values were 0.2 mg./l at Cushing Bridge, 1.2 mg./l at Stier's Ranch, 0.65 mg./l at Carseland and 0.72 mg./l at Cluny. On the Sheep

River an average of 0.25 mg./l was observed. The averages indicate slightly higher ammonia-nitrogen concentrations present than in the previous year's survey. The maximum, median and minimum are indicated in Appendix A-8.

Nitrate-Nitrogen

Nitrate-nitrogen values ranged from a low of 0 at Cushing Bridge (November 23, 1971) to a maximum of 1.6 mg./l at Stier's Ranch (January 25, 1972). The average ammonia-nitrogen values were 0.07 mg./l at Cushing Bridge, 0.7 mg./l at Stier's Ranch and Carseland and 0.5 mg./l at Cluny. On the Sheep River, the nitrate-nitrogen ranged from 0.2 mg./l to 0.7 mg./l and averaged 0.5 mg./l. The appropriate data is plotted in Appendix A-9.

Total Phosphorous

Twenty total phosphorous samples were gathered and analyzed on the Bow River basin. Of these samples, fifteen indicated values in excess of the water quality criteria value of 0.15 mg./l. Only one station, Cushing Bridge, indicated all values (four samples) within the criteria.

The total phosphorous values ranged from 0.4 mg./l to 0.9 mg./l at Stier's Ranch, averaging 0.7 mg./l; from 0.3 mg./l to 1.1 mg./l at Carseland, averaging 0.7 mg./l; and from 0.2 mg./l to 0.7 mg./l at Cluny, averaging 0.5 mg./l. These values are similar to the values obtained during last year's survey. The maximum, median and minimum are indicated in Appendix A-10.

On the Sheep River the total phosphorous values ranged from 0 to 0.4 mg./l and averaged 0.2 mg./l.

Threshold Odor Number

The water quality criteria maximum odor number of eight was not exceeded during the sampling season. However, an odor number of eight was obtained on November 24, 1971 at Stier's Ranch and on December 12, 1971 at both Carseland and Cluny.

Oil and Grease

Oil and grease concentrations in excess of 15 mg./l are generally visible as an iridescent sheen. The maximum value measured during the 1971-1972 winter survey was 2.3 mg./l at Cushing Bridge on February 9, 1972. This maximum value is well within the Provincial criteria.

Oil and grease concentration values at Cushing Bridge ranged from 0.3 mg./l to 2.3 mg./l and averaged 1.1 mg./l. At Stier's Ranch, values ranged from 0.6 mg./l to 2.0 mg./l and averaged 1.3 mg./l. At Carseland, values ranged from 0.5 mg./l to 1.0 mg./l and averaged .7 mg./l. At Cluny, values ranged from 0.3 mg./l to 1.6 mg./l and averaged .9 mg./l. All maximum and average values indicated a decrease in this pollutant concentration when compared to last year's values, even though the oil and grease loading to the Bow was substantially higher this year.

Phenolics

The presence of phenolics in a river is objectionable because of its toxicity to fish at high concentrations (100 pph), and the unpleasant taste and odors produced at low concentrations (less than 5 ppb), when

water containing phenolics is chlorinated. The water quality criteria value for phenolics of 5 ppb. was not exceeded in any of the samples collected during the indicated phenolics sampling period.

The high value at Cushing Bridge and Stier's Ranch of 3 ppb. phenolics occurred on February 9, 1972. The Carseland phenolic maximum of 2 ppb. and the Cluny maximum of 3 ppb. phenolics both occurred on January 7, 1971. The maximum value in the survey, of 4 ppb. phenolics, occurred on January 25, 1972 on the Sheep River at highway 2.

A comparison to the previous years' data (1968-71) indicates a continuation of the decreasing trend. This trend correlates with the reduced phenolic loadings on the Bow River. The maximum, median and minimum values for the 1971-72 survey are plotted in Appendix A-11.

Heavy Metals

Eleven heavy metals were analyzed during the 1971-1972 winter survey. This is the second year for reporting on these constituents.

Zinc

Fourteen samples were analyzed for zinc, of which two values exceeded the water quality criteria of 50 ppb. The maximum value of 75 ppb. zinc was observed at the Cushing Bridge sampling location on February 9, 1972. This maximum is the peak value obtained to date.

Selenium

One of the fifteen samples analyzed for selenium indicated a value in excess of the water quality criteria of 10 ppb. The

sample was gathered on November 24, at the Stier's Ranch site, and indicated a value of 20 ppb. selenium. Again this is the peak value obtained to date.

Manganese

Fifteen samples were analyzed for manganese, of which one, observed on February 9, 1972 at the Carseland site, exceeded the water quality criteria value of 50 ppm. The high value was 120 ppb. manganese and is the peak value obtained to date.

Mercury

Ten samples were analyzed for mercury. Analysis limitations did not allow measurements below 0.5 ppb. to be obtained this year. Six samples recorded values in excess of the instrument limitation range. The peak value of 5.1 ppb. was observed at the Cluny site on February 9, 1972. The reasons for the high mercury results are being further investigated.

Other Metals

The maximum arsenic value of 4 ppb. was obtained at the Cluny and Sheep River sites on November 24, 1972 (water quality criteria value is 10 ppb.). All cadmium values were 1 ppb. or less (water quality criteria value is 10 ppb.). Chromium recorded a maximum value of 40 ppb. at the Cushing Bridge Station on February 9, 1972 (water quality criteria value is 50 ppb.). Two copper values of 17 ppb., slightly less than the water quality criteria value of 20 ppb., were recorded on the Sheep River.

A maximum of 20 ppb. of lead was obtained on five occasions. These lead values are considerably lower than the water quality criteria value of 50 ppb. The maximum cobalt reading of 10 ppb. occurred on February 9 at the Carseland site. The maximum nickel value was 25 ppb. observed at Stier's Ranch on February 8, 1972.

Summarizing the eleven heavy metals, five indicated maximums less than or equal to last year's peaks (cadmium, cobalt, chromium, lead, arsenic).

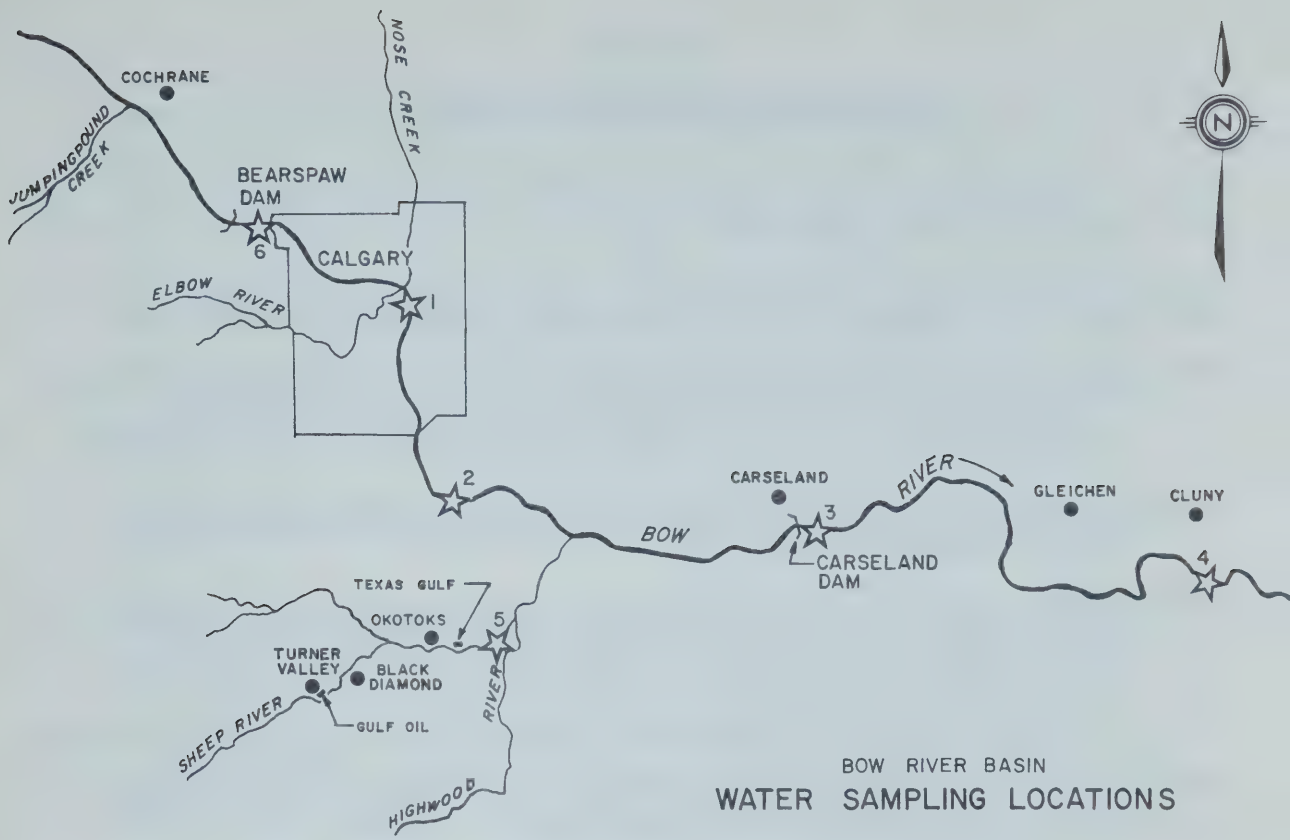
Bacteriological Constituents

Bacteriological constituents measured during this year's survey include most probable number (MPN) of total coliform, E Coli and standard plate count. All coliform samples registered values within the surface water quality criteria. The MPN total coliform ranged from 0 to 3,900 organisms/100 ml. (maximum being measured at Stier's Ranch on January 25, 1972); the E Coli ranged from 0 to 200 organisms/100 ml. (approximately one-half of the samples recorded zero); and the standard plate count ranged from 2,200 to 900,000 colonies/ml.

Summary

The Bow River did not suffer markedly from the pollution load imposed on it during the survey period. The 1% frequency flow of 1,200 c.f.s. compares favorably with the 16-year flow value of 1,120 c.f.s. The average organic loading of biochemical oxygen demand constituents increased over last year, but are down substantially from the pre-Bonneybrook secondary treatment plant era. Total phosphorous and

phenolic river loadings decreased, while oil and grease and ammonia-nitrogen river loadings increased when compared to last year's loadings. Dissolved oxygen, threshold odor number, oil and grease, phenolics and bacteriological constituents measured in the Bow indicated concentrations at satisfactory levels. Nutrient levels were quite similar to the last survey with the majority (75%) of the total phosphorous in excess of the criteria. Of the heavy metals monitored zinc, selenium, manganese and mercury measured at least one value in excess of the appropriate water quality criteria. In particular, the mercury levels warrant more detailed monitoring.



BOW RIVER BASIN

WATER SAMPLING LOCATIONS

● - INDUSTRIAL EFFLUENTS

GLOSSARY

WATER POLLUTION CONTROL TECHNOLOGY

This is a selected list containing the key terms likely to be encountered in water pollution control technology.

ABSORPTION - The taking up of one substance into the body of another.

ACID - Most commonly refers to a large class of chemicals having a sour taste in water, ability to dissolve certain metals, bases or alkalies to form salts and to turn certain acid-base indicators to their acid form. Characterized by the hydrated H^+ ion.

ABSORPTION - The taking up of one substance upon the surface of or interface zone of another substance.

ADVANCED WASTE TREATMENT - Renovation of used water by biological, chemical or physical methods that are applied to upgrade water quality for specific reuse requirements. May include more efficient cleanup of a general nature or the removal of components that are inefficiently removed by conventional treatment processes.

AERATION - The operation of adding oxygen to, removing volatile constituents form, or mixing a liquid by intimate contact with air.

AEROBIC - A condition characterized by an excess of dissolved oxygen in the aquatic environment.

AEROBIC BACTERIA - Organisms that require dissolved oxygen in the aquatic environment to enable them to metabolize or to grow.

ALGAE - Primitive plants, one or many celled, usually aquatic and capable of growth on mineral materials via energy from the sun and the green coloring material, chlorophyll. Generally considered as the primary source of food for all other organisms.

ALKALINITY - A term used to represent the sum of the effects opposite in reaction to acids in water. Usually due to carbonates, bicarbonates and hydroxides; also including borates, silicates and phosphates.

ANAEROBIC - A condition in which dissolved oxygen is not detectable in the aquatic environment. Commonly characterized by the formation of reduced sulfur compounds from the use of bound oxygen from sulfates as a hydrogen acceptor.

ANAEROBIC BACTERIA - Organisms that can metabolize and grow in the absence of dissolved oxygen. Their oxygen supply is obtained from the bound oxygen such as in sulfates, carbonates, or other oxygen-containing compounds.

ANION - A negatively charged ion in water solution. May be a single element or a combination of elements, such as the Cl^- ion in a water solution of NaCl (common table salt) or $SO_4^=$ ion in a sulfuric acid solution.

ASSESSMENT - A legal financial obligation of the property owner in an irrigation, water, drainage or sanitary district, created for the purpose of financing the construction and operation of facilities required to protect and enhance public benefit within the district.

BACTERIA - Primitive organisms having some of the features of plants and animals. Generally included among the fungi. Usually do not contain chlorophyll, hence commonly require preformed organic nutrients among their foods. May exist as single cells, groups, filaments, or colonies.

BENTHIC DEPOSIT (BENTHOS) - Refers to the accumulated deposition of cell mass living or dead that collects at the bottom of a stream impoundment where velocity or catchment permits.

BIO-CHEMICAL - Resulting from the combined activities of biological and chemical transformations. Usually measured in terms of the ensuing chemical changes.

BIODEGRADATION - The stabilization of wastewater contaminants by biological conversion of pollutants into separatable materials at a higher oxidation state.

BIOLOGICAL PROCESSES - Activities of living organisms to sustain life, growth, and reproduction. Commonly the processes by which organisms degrade complex organic material into simpler substances at a higher oxidation state to obtain energy for life processes and growth of new cell mass.

BOD - Biological or biochemical oxygen demand. A test for estimation of waste-water polluting effects in terms of the oxygen requirements for bio-chemical stabilization under specified conditions and time.

BUFFER ACTION - An action exhibited by certain chemicals that limits the change in pH upon addition of acid or alkaline materials to the system. In surface water, the primary buffer action is related to carbon dioxide, bicarbonate and carbonate equilibria.

CARBOHYDRANTES - Naturally occuring compounds consisting of carbon, hydrogen and oxygen, that are considered as energy foods and precursors of proteins and fats in the natural food chain.

CATION - A positively charged ion in water solution. May be a single element or a combination of elements, such as Na^{+} in a water solution of NaCl (common table salt).

CHLOROPHYLL - The green coloring material or pigments in plants that promotes the photoshynthetic reactions forming organic materials from inorganic nutrients and light energy within the living cells.

CLARIFIER - A basin or chamber serving as an enlargement of a channel to reduce flow velocity sufficiently to permit separation of settleable or float-able materials from the carrier water (a sedimentation basin).

COAGULANT - A chemical, or chemicals, which when added to water suspensions will cause finely dispersed materials to gather into larger masses of improved filterability, settleability, or drainability.

COAGULATION - The process of modifying chemical, physical, or biological conditions to cause flocculation or agglomeration of particulates.

COD - A test for the estimation of the contamination of a wastewater in terms of oxygen requirements from a strong chemical oxidant under specified conditions, i.e., Dichromate, 50% sulfuric acid and 145°C for 2 hours.

COLIFORM GROUP - A group of bacteria that inhabits the intestinal tract of man, warm-blooded animals, and may be found in plants, soil, air and the aquatic environment. Includes aerobic and facultative gram negative non-spore forming bacilli that ferment lactose with gas formation.

COLLOID, COLLOIDAL STATE - A state of suspension in which the particulate or insoluble materials is in a finely divided form that remains dispersed in the liquid for extended time periods. Usually cloudy or turbid suspensions requiring flocculation before clarification.

CONCENTRATION -

a) The act of increasing the mass per unit volume of one substance with respect to another, such as concentrating the solids in a sludge from 3% to 6%.

b) A means of designating the ratio of one substance with respect to another, such as 15 mg of suspended solids per liter of water.

CRITERION (pl. CRITERIA) - Something which can be measured. Commonly used as a basis for standards.

CUBIC FOOT PER SECOND (c.f.s.) - A unit of discharge rate such as one cubic foot of water per second past a given point.

DATA - Records of observations or measurements of facts, occurrences and conditions in written, graphical or tabular form.

DEGRADE - To reduce the complexity of a chemical compound.

DENITRIFICATION -

a) The conversion of oxidized nitrogen (nitrate and nitrite-N) to nitrogen gas by contact with septic wastewater solids or other reducing chemicals.

b) A reduction process with respect to oxidized nitrogen.

DETERGENT - Something used for cleaning. Commonly consists of soap or surfactant plus various additives or associated materials.

DILUTION -

a) To make thinner or more liquid.

b) A ratio, volume or weight of a more concentrated sample or effluent flow compared to that into which it is discharged.

DISSOLVED -

a) Those materials dispersed in water in ionic, atomic, or molecular form; an homogenous mixture or solution.

b) Generally clear but may be colored

c) Present in true solution form.

DISSOLVED OXYGEN (D.O.) - Dissolved molecular oxygen usually expressed in mg DO/l or percent of saturation.

ECOLOGY - The relation of an organism to its environment; i.e., how is an organism affected by its surroundings such as air, water, heat, noise, contamination, etc.

EFFLUENT - A liquid or product water discharged from a chamber, basin or other treatment operation.

ENTERIC ORGANISMS - Those organisms commonly associated with the intestinal tract.

ENTRAINMENT - A condition or action that will cause an immiscible substance to be mixed with another. Usually the result of turbulence or entrapment; i.e., air bubbles in aqueous media.

ENZYME - A soluble or collodial organic catalyst produced by a living organism. Usually they are simple or conjugated proteins that catalyze specific reactions.

EUTROPHIC - Well nourished; rich in dissolved nutrients.

EUTROPHICATION - An action involving the aging of lakes characterized by nutrient enrichment and increasing growth of plant and animal organisms. The net effect is to decrease depth until the lake becomes a bog and eventually dry land. Man-made pollution tends to hasten the process.

FACULTATIVE BACTERIA - Bacteria that can adapt themselves to growth and metabolism under aerobic or anaerobic conditions. Many organisms of interest in wastewater stabilization are among this group.

FLOC - Gelatinous or amorphous solids formed by chemical, biological or physical agglomeration of fine materials into larger masses that are more readily separated from the liquid.

FUNGI - Simple or complex organisms without chlorophyll. The simpler forms are one-celled; higher forms have branched filaments and complicated life cycles. Examples are molds, yeasts and mushrooms.

HARDNESS - Commonly refers to the chemicals interfering with soap action or producing scale in boilers or heating units. Specifically refers to Calcium and Magnesium salts; sometimes including iron, aluminum, and silica.

INDICATOR - May include the color change of a dye, electronic sensor response, or other means of estimating the equivalence point of a reaction between two different materials.

INFLUENT - That material entering a process unit or operation.

INORGANIC - Being composed of material other than plant or animal materials. Forming or belonging to the inanimate world.

LAGOON - A natural or artificial basin used for storage and/or stabilization of wastewater or sludge. Sometimes used for indefinite storage for disposal purposes. Commonly the lagoon depth is greater than a wadable depth but not greater than twenty feet.

LOAD - The load to a process is that which is contained in the inflow to that process. It may be expressed as hydraulic, oxygen demand, solids, or other criteria.

MICRO ORGANISMS - Commonly an organism too small to be observed individually by the human eye without optical aid.

MG/L - A unit of concentration on a weight/volume basis: Milligrams per liter. Equivalent to ppm when the specific gravity of the liquid is 1.0.

MIXING ZONE - An area where two or more substances of different characteristics blend to form a uniform mixture; i.e., chlorine application, heated water, or other discharged materials entering a water mass will show significant differences of chlorine residual, temperature or other criteria, depending upon the sampling location throughout the mixing zone and approach uniform results with respect to lateral,longitudinal, and vertical sampling positions when mixing has been completed.

MOST PROBABLE NUMBER (MPN) - A statistical method of determining microbial populations. A multiple dilution tube technique is utilized with a standard medium and observations are made for specific individual tube effects. Resultant coding is translated by mathematical probability tables into population numbers.

NITRIFICATION - The biochemical conversion of unoxidized nitrogen (ammonia) and organic N) to oxidized nitrogen (usually nitrate).

NUTRIENTS -

a) Anything essential to support life.

b) Includes many common elements and combinations of them. The major nutrients include carbon, hydrogen, oxygen, nitrogen, sulfur, and phosphorus.

c) Nitrogen and phosphorus are of major concern because they tend to recycle and are hard to control.

OILS -

a) Liquid facts of animal or vegetable origin.

b) Oily or waxy mineral oils.

OXIDATION POND - A shallow basin employed for the stabilization of wastewaters.

OXYGEN DEPLETION - The loss of oxygen from water or sewage due to biological, chemical or physical action.

PARASITE - A living organism deriving its nutrients at the expense of another living organism, giving nothing in return.

PARSHALL FLUME - A device for estimation of the flow in an open conduit. Consists of a constructing section, a throat, and an expanding section. The throat contains a sill over which the liquid passes. The pressure change over the sill can be related to quantity of flow.

PARTS PER MILLION (PPM) - A unit of concentration signifying parts of some substances per million parts of dispersing medium. Equivalent numerically to mg/l only when the specific gravity of the solution is 1.0.

PATHOGENIC ORGANISMS - Bacterial, fungal, viral, or other organisms directly involved with diseases of plants, animals, or man, are included among this group.

pH - An index of hydrogen ion activity. Defined as the negative logarithm (base 10) of H^+ ion concentration at a given instant. On a scale of 0 to 14 pH 7.0 is neutral, pH less than 7.0 indicates a predominance of H^+ or acid ions; pH greater than 7.0 indicates a predominance of OH^- or alkaline ions.

POLLUTION - Anything appearing in water that renders it unacceptable in terms of established water quality standards. Commonly conditions or contaminants that interefere with subsequent beneficial uses of the water.

PRIMARY TREATMENT - Commonly the separation of settleable or floatable materials from carrier water. Usually proceded by pretreatment such as coarse screens, grit separation, comminution.

SATURATION - Commonly refers to the maximum amount of any material that can be dissolved in water or other liquid at a given temperature and pressure. For oxygen, this commonly refers to a percentage saturation in terms of the saturation value, such as about 9 mg O_2/l at 20°C.

SECOND FOOT - An abbreviation for cubic foot per second. A rate term.

SECONDARY TREATMENT - Processes used to convert dissolved and collodial materials in wastewater to a form that may be separated from the water. Commonly consists of biodegradation and conversion to cell mass in a separatable form with partial oxidation, such as in activated sludge, trickling filtration, or oxidation ponds.

SETTLEABLE SOLIDS -

a) Includes materials that will settle by gravity under low flow velocities.

b) Commonly expressed in terms of the volume of solids accumulating in an Imhoff cone after one hour on a volume basis.

SEWER - A pipe or conduit, generally covered, for the purposes of conveying wastewaters from the point of origin to a point of treatment or discharge.

SEWERAGE SYSTEM - A system of sewers and appurtenances for the collection, transportation and pumping of used waters for a given area or basin. Any treatment device or facility and its outfall conduit are a part of the system.

SLIME-SEWAGE SLIMES- Consisting of organisms growing on wastewater nutrients with the formation of mucilaginous covering, streamers or clumps. May consist of bacteria, molds, protozoa or algae.

STABILIZATION -

a) The activity proceeding along the pathway to stability.

b) In organic wastes, generally refers to oxidation via biochemical pathways and conversion to gaseous or insoluble materials relatively inert to further change.

STANDARD - Something set by authority. Having qualities or attributes required by law and defined by minimum or maximum limits of acceptability in terms of established criteria or measurable indices.

STANDARD METHODS - Methods of analysis prescribed by joint action of APHA, ASCE, AWWA, and FWPCA. Methods accepted by authority.

SUBSTRATE -

a) The base or media in which an organism lives.

b) The liquid in an activated sludge aeration tank.

SURFACTANT -

a) A chemical that, when added to water, will greatly reduce the surface tension of the solution.

b) The surface active component in a detergent mixture.

SUSPENDED SOLIDS - The concentration of insoluble materials suspended or dispersed in waste or used water. Generally expressed in mg/liter on a dry weight basis. Usually determined by filtration methods.

SYNERGISM - Refers to the action produced when two or more substances in combination have a greater effect than that produced by the additive effects of each one separately.

THERMAL POLLUTION - Refers to heated discharges to surface waterways. The largest contributor of heated discharges is associated with power production.

TOC - Total Organic Carbon. A test espressing wastewater contaminant concentration in terms of the carbon content.

TOTAL SOLIDS - Refer to the solids contained in dissolved and suspended form in water. Commonly determined on a weight basis by evaporation to dryness.

VELOCITY (FLOW) - A rate term expressed in terms of linear movement per unit of time. Commonly expressed in ft. per sec. (English) or cm/sec(Metric).

VOLATILE MATERIAL -

a) Refers to those chemicals having a vapor pressure low enough to evaporate from water readily at normal temperatures.

b) With reference to dry solids, the term includes loss in weight upon ignition at 600^{o}C.

WATER QUALITY CRITERIA - Includes selected analytical measurements with limits designated to be acceptable or unacceptable in reference to water quality standards.

WATER QUALITY STANDARDS - Limits set by authority on the basis of water quality criteria required for beneficial uses.

WASTEWATER - Refers to the used water of a community. Generally contaminated by the waste products from household, commercial or industrial activities. Often contains surface wash, storm water and infiltrations water.

INDEX TO APPENDICES

APPENDIX A

Bow River Daily Flow Rate at Calgary	A-1
Bow River Statistical Flow Rate Distribution	A-2 & A-3
Bow River Basin Users & Effluent Discharges	A-4 & A-5
Total Loadings to the Bow	A-6
Maximum, Median and Minimum Value for	
Dissolved Oxygen	A-7
Biological Oxygen Demand	A-8
Ammonia Nitrogen	A-9
Nitrate & Nitrite Nitrogen	A-10
Phosphate	A-11
Phenolics	A-12

APPENDIX B (Not included in Short Report)

ANALYTICAL DATA

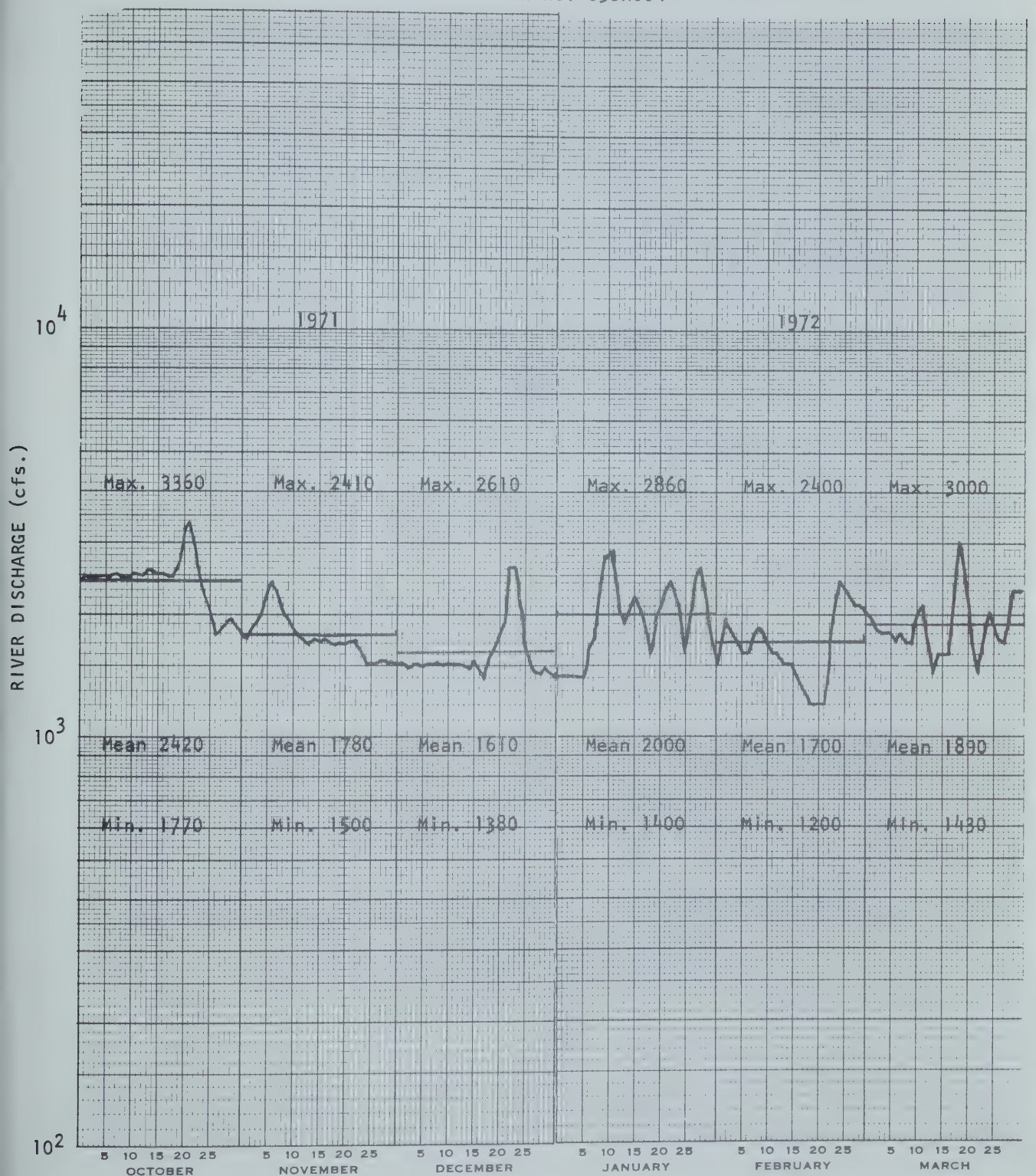
Bow River at	
Cushing Bridge	B-1
Stier's Ranch	B-2
Carseland	B-3
Cluny	B-4
Sheep River at	
Highway Number 2	B-5

GRAPHS OF RIVER PROFILE B-9 to B-13

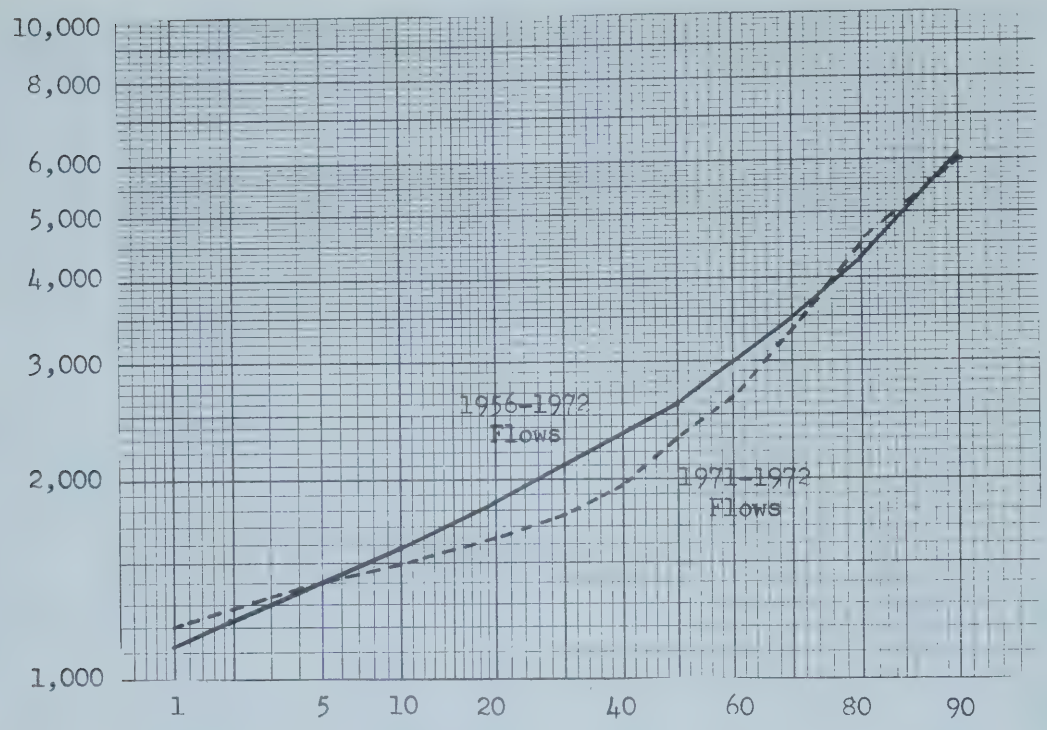
APPENDIX A

BOW RIVER DAILY FLOW RATES AT CALGARY

STATION NO. 05BH004



STATISTICAL FLOW ANALYSIS OF THE BOW RIVER AT CALGARY



FREQUENCY OF OCCURRENCE LESS THAN INDICATED (Per Cent)

1956 - March 1971

Maximum Flow - 16,100 c.f.s.
Minimum Flow - 680 c.f.s.

April 1971 - March 1972

Maximum Flow - 12,800 c.f.s.
Minimum Flow - 1,050 c.f.s.

DEPARTMENT OF THE ENVIRONMENT

DIVISION OF POLLUTION CONTROL

STATISTICAL FLOW ANALYSIS FOR THE BOW RIVER AT CALGARY

1956 - March 72

There are 5935 pieces of data

The minimum flow is 680 cubic feet per second

1%	of the time the flow is less than	1120 cubic feet per second
5%	of the time the flow is less than	1400 cubic feet per second
10%	of the time the flow is less than	1580 cubic feet per second
20%	of the time the flow is less than	1860 cubic feet per second
30%	of the time the flow is less than	2120 cubic feet per second
40%	of the time the flow is less than	2360 cubic feet per second
50%	of the time the flow is less than	2615 cubic feet per second
60%	of the time the flow is less than	2970 cubic feet per second
70%	of the time the flow is less than	3480 cubic feet per second
80%	of the time the flow is less than	4280 cubic feet per second
90%	of the time the flow is less than	6100 cubic feet per second

The maximum flow is 16,100 cubic feet per second

Apr. 71 - Mar. 72

There are 366 pieces of data

The minimum flow is 1050 cubic feet per second

1%	of the time the flow is less than	1200 cubic feet per second
5%	of the time the flow is less than	1400 cubic feet per second
10%	of the time the flow is less than	1500 cubic feet per second
20%	of the time the flow is less than	1640 cubic feet per second
30%	of the time the flow is less than	1770 cubic feet per second
40%	of the time the flow is less than	1960 cubic feet per second
50%	of the time the flow is less than	2300 cubic feet per second
60%	of the time the flow is less than	2650 cubic feet per second
70%	of the time the flow is less than	3360 cubic feet per second
80%	of the time the flow is less than	4550 cubic feet per second
90%	of the time the flow is less than	6010 cubic feet per second

The maximum flow is 12,800 cubic feet per second

BOW RIVER BASIN USERS AND EFFLUENT DISCHARGES

A. INDUSTRY	Type of Waste Water and Treatment	
Alberta Natural Gas Co. (Cochrane)	Cooling Water Blowdown	-
Canadian Fina Oil Ltd. (Wildcat Hills)	Industrial Waste	- Secondary Aeration
Gulf Oil Canada Ltd. (Calgary)	Industrial Waste	- API Separator & Stripper
Imperial Oil Limited (Calgary)	Industrial Waste	- API Separator & Stripper
Cominco Ltd. (Calgary)	Industrial Waste	- Internal product recovery
Western Co-op Fertilizer (Calgary)	Industrial Waste	- Lagoon
Shell Gas Plant (Jumping Pound)	Industrial & Domestic waste	- Strippers & aerated lagoon
Gulf Oil Limited (Turner Valley)	Industrial & Domestic Waste	- Separator
Texas Gulf Sulphur Co. (Okotoks)	Industrial & Domestic Waste	- Lagoon
B. MUNICIPALITY		
Banff	Domestic Waste	- Secondary
Canmore	Domestic Waste	- Lagoon short detention
Cochrane	Domestic Waste	- Septic Tank
Calgary Bonnybrook Sewage Treatment Plant	Domestic & Industrial Waste	- Secondary
Calgary Ogden Sewage Treatment Plant	Domestic Waste	- Primary
Calgary Fish Creek Sewage Treatment Plant	Domestic Waste	- Primary
Gleichen	Domestic Waste	- Lagoon-long detention

BOW RIVER BASIN USERS AND EFFLUENT DISCHARGES

B. MUNICIPALITY

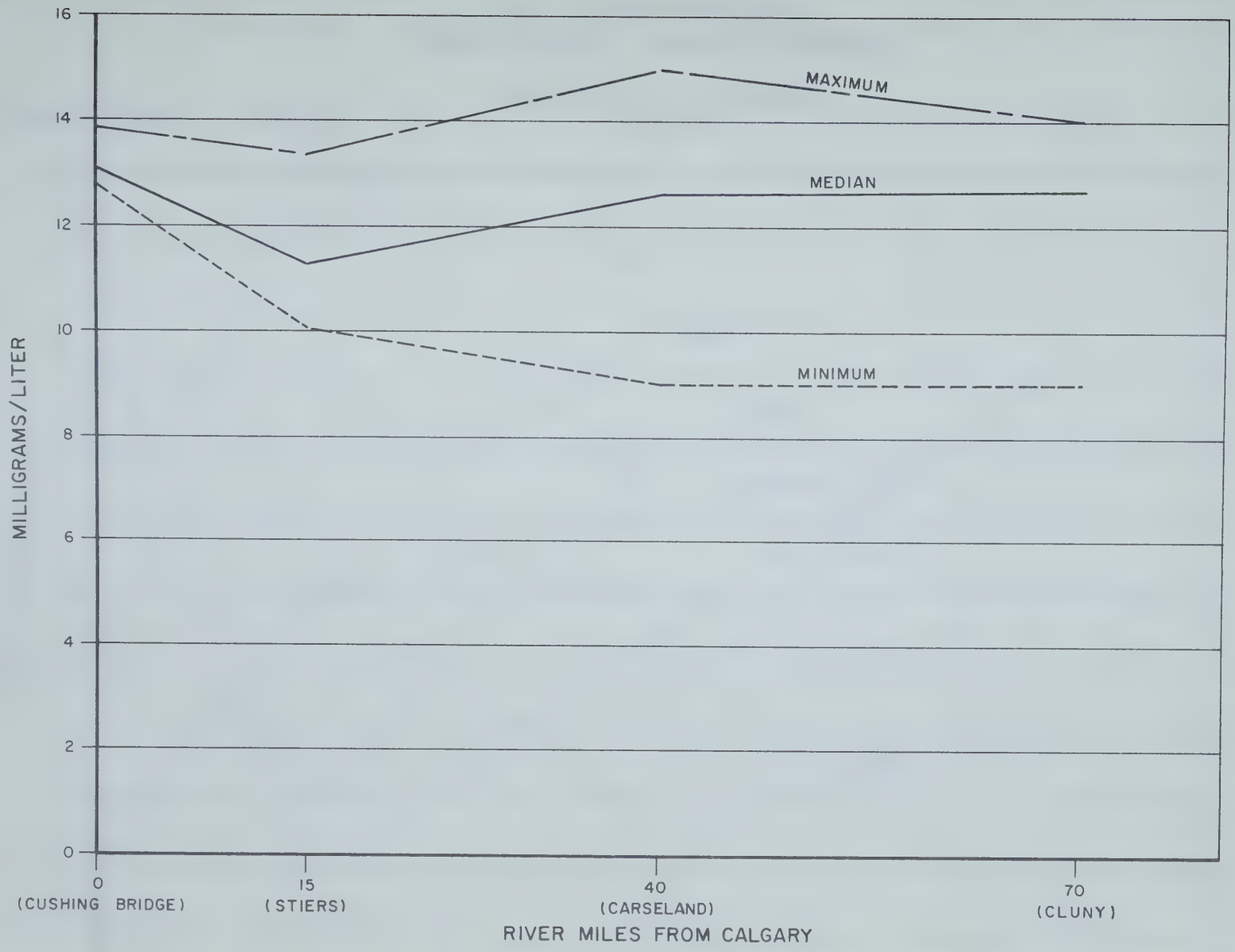
Bassano	Domestic Waste	- Treatment proposed
Okotoks	Domestic Waste	- Imhoff tank
High River	Domestic Waste	- Lagoon - long detention
Turner Valley	Domestic Waste	- Lagoon - long detention
Black Diamond	Domestic Waste	- Lagoon - long detention

C. DRINKING WATER USERS

User	Treatment
Bassano	Gravity filters
Cochrane	Filtration, chlorination
Calgary	Complete

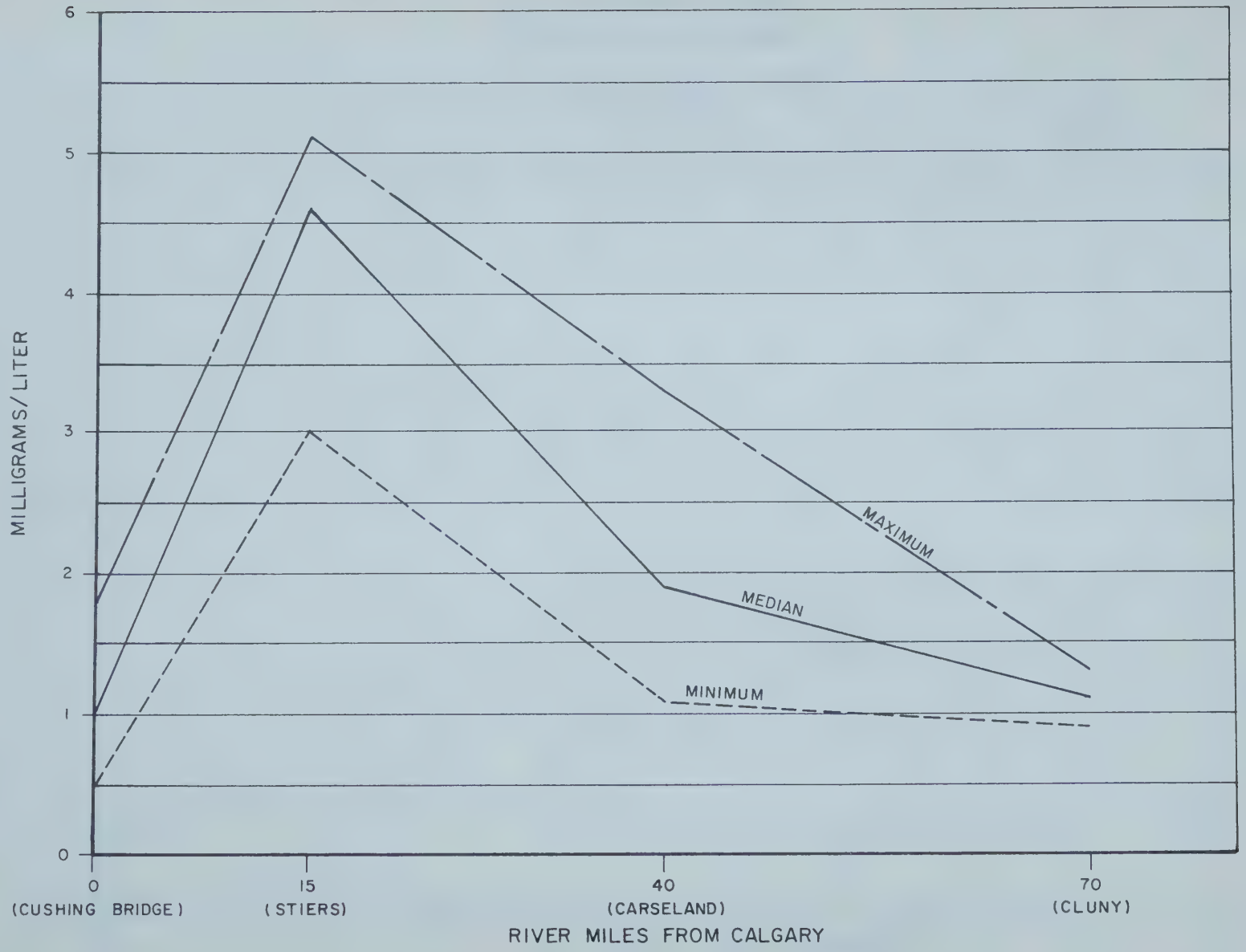
TOTAL LOADINGS TO THE BOW RIVER IN LBS/DAY

	Nov.23-24/71	Dec.7/71	Jan.25-26/72	Feb.8-10/72
Biochemical Oxygen Demand	39,500	19,500	28,400	11,600
Chemical Oxygen Demand	84,900	149,800	58,200	31,800
Alkalinity pp as $CaCO_3$	180	80	540	20
Total Alkalinity as $CaCO_3$	213,000	233,900	203,700	210,900
Total Residue	894,400	394,200	522,300	420,100
Ignition Loss	160,100	103,200	235,300	146,400
Nonfilterable Residue	21,600	18,000	35,700	24,100
Ignition Loss	17,600	11,500	17,300	9,670
Chlorides	31,200	35,300	37,200	44,600
Total Phosphorous as PO_4	5470	8300	8930	6660
Ammonia Nitrogen	12,800	27,500	9,130	10,800
Nitrate Nitrogen	1950	2200	730	1510
Sulphates	17,200	20,600	74,300	82,100
Phenols	30	12	9	20
Oil and Grease	19,200	3,130	8490	2800
Hexavalent Chromium	2	2	-	-
Fluorides	73	34	78	50



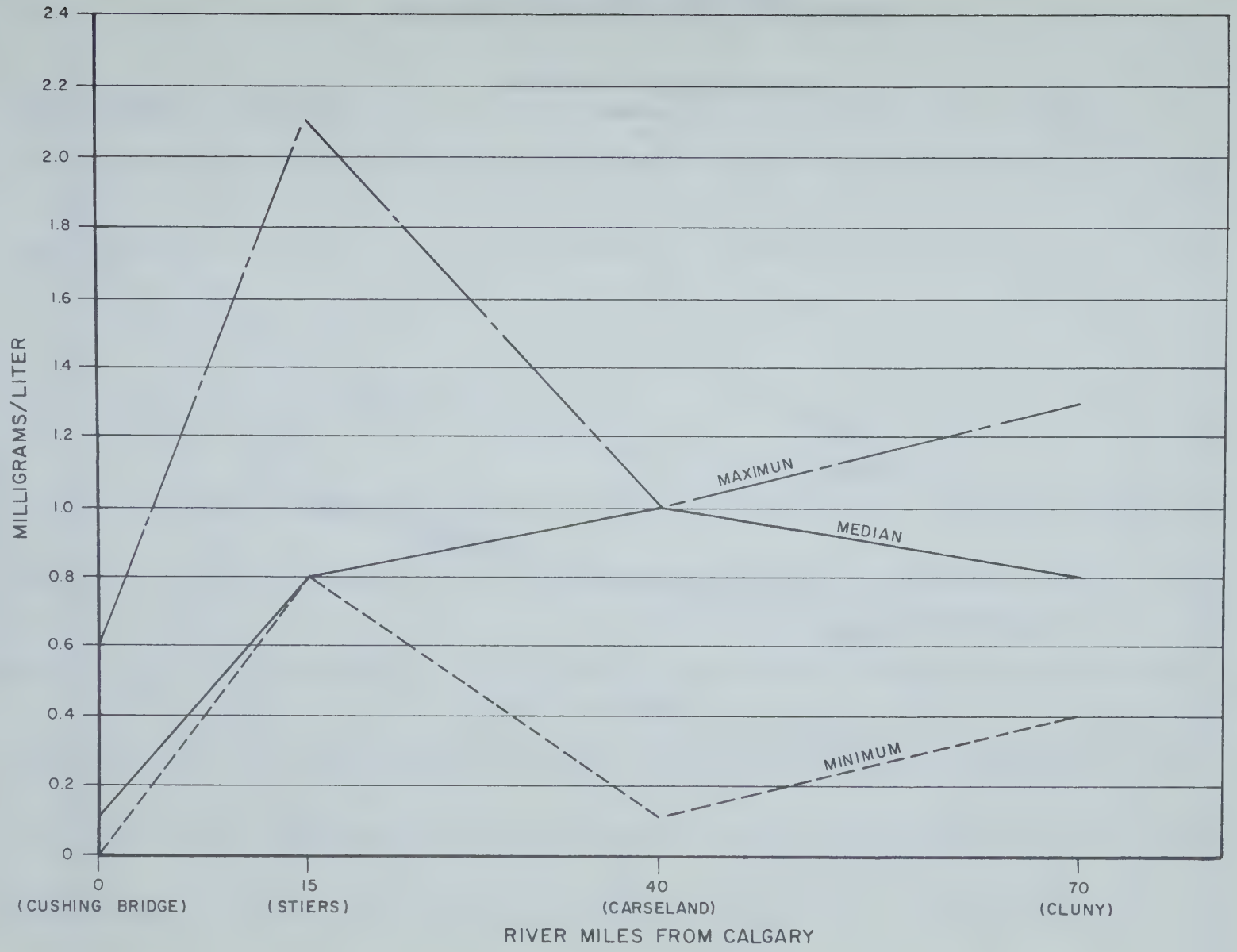
DISSOLVED OXYGEN

1971-72 BOW RIVER SURVEY



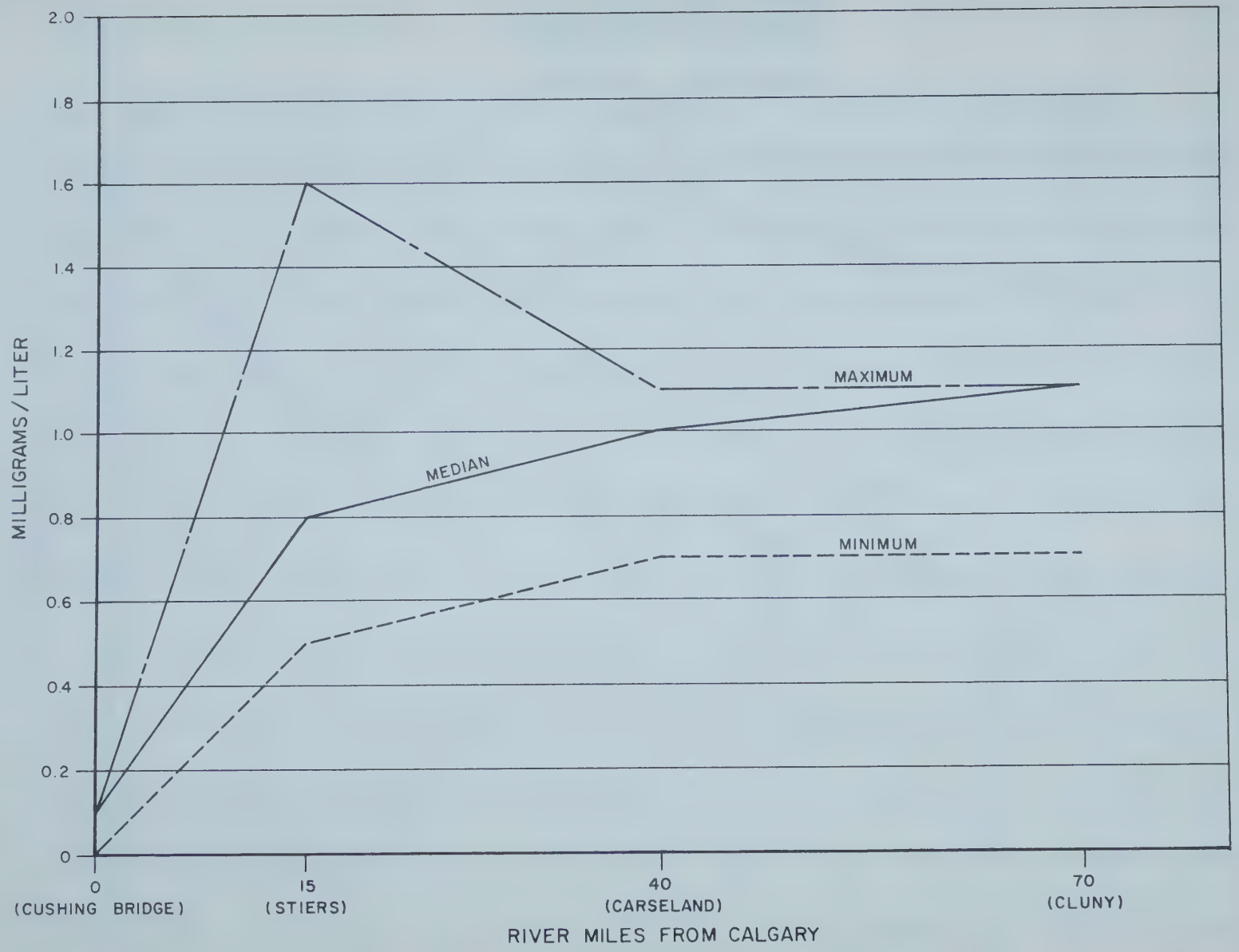
BIOCHEMICAL OXYGEN DEMAND

1971-72 BOW RIVER SURVEY

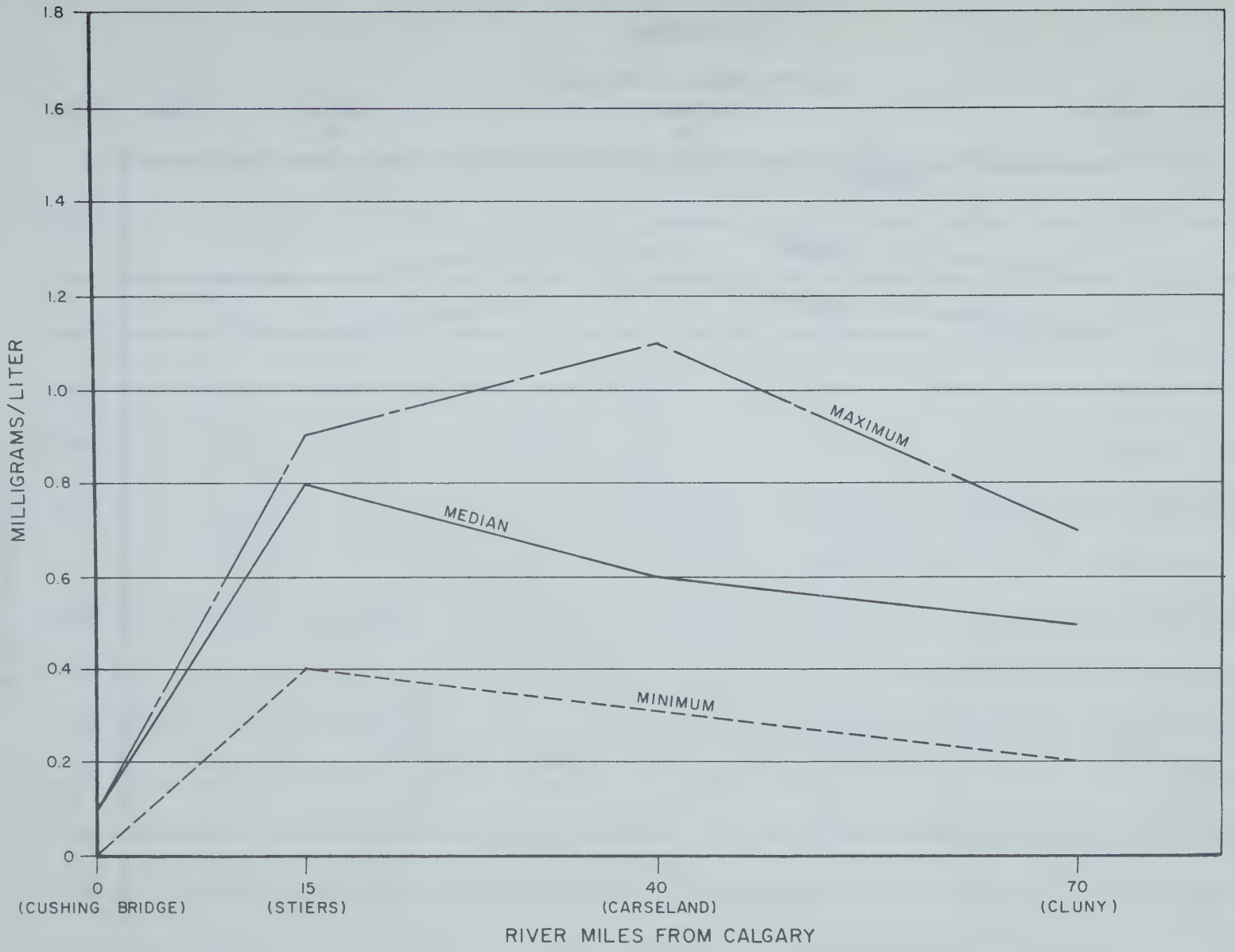


AMMONIA - NITROGEN

1971 - 72 BOW RIVER SURVEY

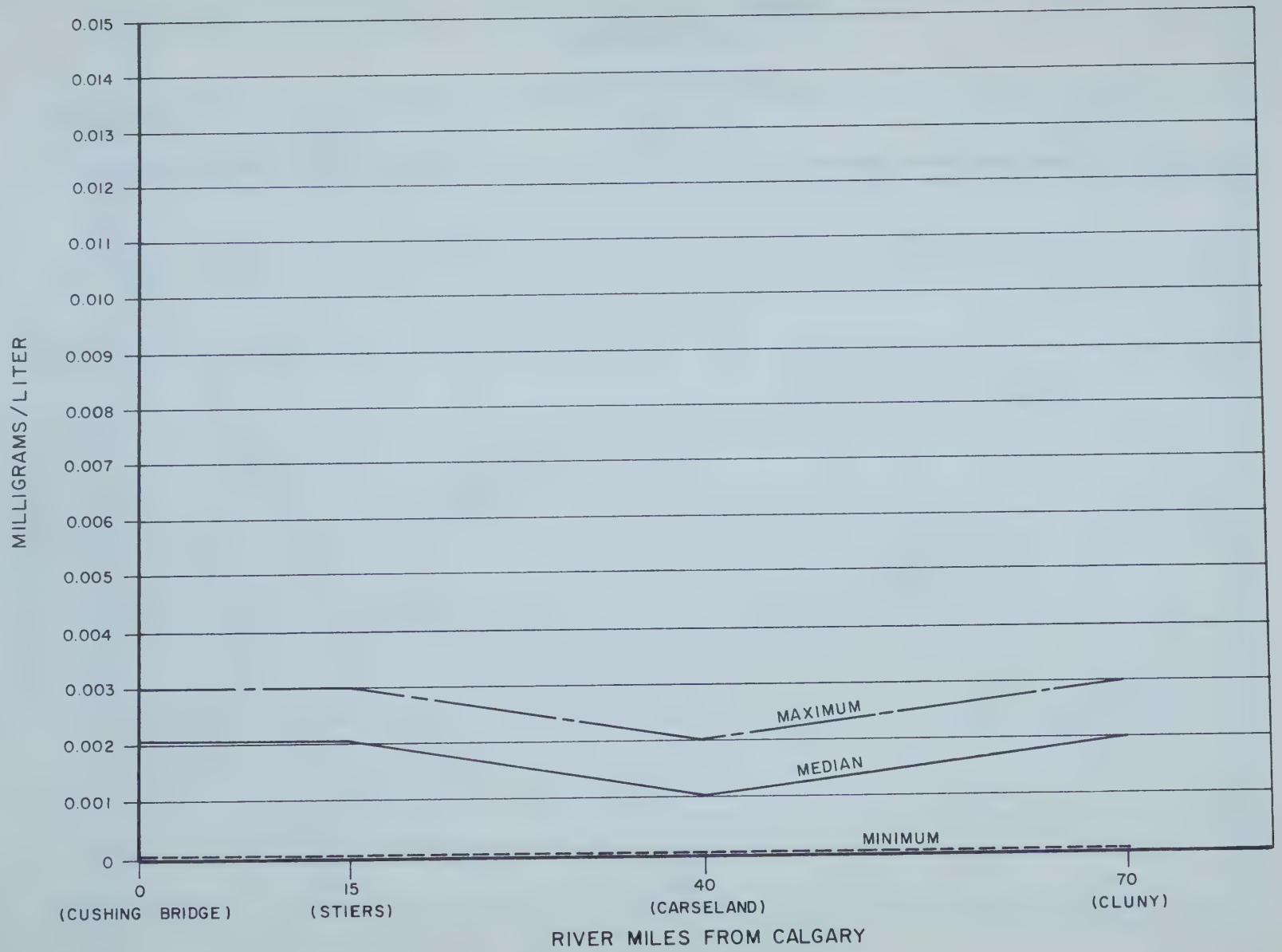


NITRATE AND NITRITE NITROGEN
1971-72 BOW RIVER SURVEY



PHOSPHATES

1971-72 BOW RIVER SURVEY



PHENOLS

1971-72 BOW RIVER SURVEY

APPENDIX B

BOW RIVER DATA

STATION 00AT05BH2140 LATITUDE 51D 02M 12S LONGITUDE 114D 00M 57S

BOW RIVER CUSHING BRIDGE

SAMPLE DATE TIME MST D M Y H M	08202L OXYGEN BIOCHEMICAL DEMAND 02 MG/L	02001L ODOUR THRESHOLD ODOUR NUMBER T.O.N	06531L PHENOLIC MATERIAL MG/L	10471L RESIDUE TOTAL MG/L	06521L OIL & GREASE O & G MG/L	36001L COLIFORM TOTAL MPN NO/100ML	36011L COLIFORM FECAL MPN NO/100ML	76000L STANDARD PLATE COUNT BACTERIAL DENSITY NO/ML
23 11 71 11 00	0.8	1	0.000	182.		5	0	15000
7 12 71 09 00	1.8	2	0.001	208.	0.6	17	0	95000
25 1 72 18 30	0.5	1	0.002	250.	0.3	21	0	50000
9 2 72 11 00	1.0	2	0.003	262.	2.3	33	68	95000

SAMPLE DATE TIME MST D M Y H M	19101L POTASSIUM DISSOLVED K MG/L	02041L SPECIFIC CONDUCTANCE UMHO/CM	97161F FLOW AVERAGE (DAILY) PROVISIONAL CU.FT/SEC	10101L ALKALINITY TOTAL CACO3 MG/L	10505L HARDNESS TOTAL CACO3 MG/L	16302L SULPHATE DISSOLVED SO4 MG/L	11101L SODIUM DISSOLVED NA MG/L	08101L OXYGEN DISSOLVED 02 MG/L
23 11 71 11 00	0.4		1590	150	150.	35.	2.	13.8
7 12 71 09 00	0.4		1500	155	195.	45.	6.	13.1
25 1 72 18 30	0.4	305	1600	130	290.0	40.0	2.0	12.7
9 2 72 11 00	0.7	275	1800	145	150.	40.0	1.3	13.0

SAMPLE DATE TIME MST D M Y H M	07551L NITROGEN DISSOLVED AMMONIA N MG/L	10301L PH PH UNITS	17201L CHLORIDE DISSOLVED CL MG/L	09105L FLUORIDE DISSOLVED F MG/L	12103L MAGNESIUM DISSOLVED MG MG/L	07106L NITROGEN DISS.NITRATE & NITRITE N MG/L	02073L TURBIDITY TOTAL TURBIDITY UNITS	15406L PHOSPHOROU TOTAL PHOSPHATE P MG/L
23 11 71 11 00	0.1	7.8	4.	0.22		0.0	3.	0.0
7 12 71 09 00	0.6	8.2	1.0	0.15		0.1	7.	0.1
25 1 72 18 30	L.1	8.0	3.0	0.25	45.0	0.1	1.0	0.10
9 2 72 11 00	0.1	7.9	11.	0.05	16.	L.1	1.0	0.1

SAMPLE DATE TIME MST D M Y H M	02061F TEMPERATURE DEG.C.	33003L ARSENIC TOTAL AS MG/L	48004L CADMIUM TOTAL CD MG/L	24004L CHROMIUM TOTAL CR MG/L	27004L COBALT TOTAL CO MG/L	29008L COPPER TOTAL CU MG/L	82005L LEAD TOTAL PB MG/L	25006L MANGANESE TOTAL MN MG/L
23 11 71 11 00		0.002	L.001	0.004	0.004	0.001	0.01	0.01
7 12 71 09 00	0							
25 1 72 18 30	0		L.001	0.002	0.002	0.003	0.01	0.00
9 2 72 11 00			0.001	0.040	0.005	0.001	0.01	0.00

SAMPLE DATE TIME MST D M Y H M	28004L NICKEL TOTAL NI MG/L	34003L SELENIUM TOTAL SE MG/L	30006L ZINC TOTAL ZN MG/L	80002L MERCURY TOTAL HG MG/L
23 11 71 11 00	0.002	0.010	0.013	
25 1 72 18 30	0.009	0.01	0.050	0.0005
9 2 72 11 00	0.005	0.01	0.075	0.0010

WATER QUALITY DATA

STATION 00AT05BM216C LATITUDE 50D 51M 18S LONGITUDE 113D 56M 00S

EOW RIVER STIERS RANCH

SAMPLE DATE TIME MST D	M	Y	H	M	08202L OXYGEN BIOCHEMICAL DEMAND 02 MG/L	22001L ODOUR THRESHOLD ODOUR NUMBER T.O.N	06531L PHENOLIC MATERIAL MG/L	10471L RESIDUE TOTAL MG/L	06521L OIL & GREASE O & G MG/L	36001L COLIFORM TOTAL MPN NO/100ML	36011L COLIFORM FECAL MPN NO/100ML	76900L STANDARD PLATE COUNT BACTERIAL DENSITY NO/ML
24	11	71	11	00	3.3	8	0.002	194.	2.0	23	2	21000
7	12	71	11	00	5.1	4	0.000	238.	0.6	72	0	63000
25	1	72	12	30	4.6	2	0.002	260.0	0.8	3900	200	116000
8	2	72	16	00	3.0	1	0.003	222.	1.6	19	6	30500

SAMPLE DATE TIME MST D	M	Y	H	M	12101L POTASSIUM DISSOLVED K MG/L	22041L SPECIFIC CONDUCTANCE UMHO/CM	10151L ALKALINITY PHENOL CACO3 MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10025L HARDNESS TOTAL CACO3 MG/L	16302L SULPHATE DISSOLVED SO4 MG/L	11101L SODIUM DISSOLVED NA MG/L	00101L OXYGEN DISSOLVED O2 MG/L
24	11	71	11	00	1.3				160.		6.	11.3
7	12	71	11	00	1.0				135.		8.	13.4
25	1	72	12	30	1.0	320		145	275.0	45.0	5.5	10.1
8	2	72	16	00	1.1						3.5	10.0

SAMPLE DATE TIME MST D	M	Y	H	M	07551L NITROGEN DISSOLVED AMMONIA N MG/L	10301L PH PH UNITS	17201L CHLORIDE DISSOLVED CL MG/L	09105L FLUORIDE DISSOLVED F MG/L	12103L MAGNESIUM DISSOLVED MG MG/L	07106L NITROGEN DISS.NITRATE & NITRITE N MG/L	02073_ TURBIDITY TOTAL TURBIDITY UNITS	15406L PHOSPHORUS TOTAL PHOSPHATE P MG/L
24	11	71	11	00	0.8	8.2				0.8	2.	0.4
7	12	71	11	00	2.1	7.2				1.6	7.	0.8
25	1	72	12	30		8.0	5.0		38.0	0.5	2.0	0.34
8	2	72	16	00	0.8			0.10			1.	0.5

SAMPLE DATE TIME MST D	M	Y	H	M	02061F TEMPERATURE DEG.C.	33003L ARSENIC TOTAL AS MG/L	48004L CADMIUM TOTAL CD MG/L	24004L CHROMIUM TOTAL CR MG/L	27004L COBALT TOTAL CO MG/L	29008L COPPER TOTAL CU MG/L	82005_ LEAD TOTAL PB MG/L	25006L MANGANESE TOTAL MN MG/L
24	11	71	11	00		L.002	L.001	0.008	0.002	0.002	0.01	0.01
7	12	71	11	00	0							
25	1	72	12	30	0		L.001	0.004	0.002	0.010	0.02	0.01
8	2	72	16	00			0.001	0.004	0.005	0.006	0.01	0.01

SAMPLE DATE TIME MST D	M	Y	H	M	28004L NICKEL TOTAL NI MG/L	34003L SELENIUM TOTAL SE MG/L	30006L ZINC TOTAL ZN MG/L	80002L MERCURY TOTAL HG MG/L
24	11	71	11	00	0.002	0.020	0.012	
25	1	72	12	30	0.007	0.01	0.036	0.0015
8	2	72	16	00	0.025	L.01	0.038	0.0005

WATER QUALITY DATA

STATION 00AT05BM222C LATITUDE 50D 49M 50S LONGITUDE 113D 25M 00S

BOW RIVER AT CARSELAND

SAMPLE DATE TIME MST D M Y H M	08202L OXYGEN BIOCHEMICAL DEMAND 02 MG/L	C2001L ODOUR THRESHOLD ODOUR NUMBER T.O.N	06531L PHENOLIC MATERIAL MG/L	10471L RESIDUE TOTAL MG/L	06521L OIL & GREASE O & G MG/L	36001L COLIFORM TOTAL MPN NO/100ML	36011L COLIFORM FECAL MPN NO/100ML	36900L STANDARD PLATE COUNT BACTERIAL DENSITY NO/ML
24 11 71 13 00	1.6	4	0.000	176.	1.0	540	6	6000
7 12 71 17 00	1.1	8	0.002	226.	0.7	1800	10	12000
26 1 72 10 30	1.6	4	0.001	220.0	0.6	31	0	200000
9 2 72 17 00	3.3	4	0.001		0.5	180	8.0	5300

SAMPLE DATE TIME MST D M Y H M	19101L POTASSIUM DISSOLVED K MG/L	02041L SPECIFIC CONDUCTANCE UMHO/CM	10151L ALKALINITY PHENOL CACO3 MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10605L HARDNESS TOTAL CACO3 MG/L	16302L SULPHATE DISSOLVED SO4 MG/L	11101L SODIUM DISSOLVED NA MG/L	09101L OXYGEN DISSOLVED 02 MG/L
24 11 71 13 00	1.1				150.		9.	14.9
7 12 71 17 00	0.9				200.		5.	12.6
26 1 72 10 30	0.9	315		135	250.0	45.0	5.0	10.1
9 2 72 17 00	1.3	320		150			4.4	8.9

SAMPLE DATE TIME MST D M Y H M	07551L NITROGEN DISSOLVED AMMONIA N MG/L	10301L PH PH UNITS	17201L CHLORIDE DISSOLVED CL MG/L	09105L FLUORIDE DISSOLVED F MG/L	12103L MAGNESIUM DISSOLVED MG MG/L	07106L NITROGEN DISS.NITRATE & NITRITE N MG/L	02073L TURBIDITY TOTAL TURBIDITY UNITS	15306L PHOSPHOROUS TOTAL PHOSPHATE P MG/L
24 11 71 13 00	0.5	8.2				0.7	1.1	0.3
7 12 71 17 00	1.0	8.0				1.1	0.	0.6
26 1 72 10 30	0.1	7.9	6.0		35.	0.9	0.0	0.65
9 2 72 17 00	1.0	8.2		0.10	13.	1.0	48.	1.1

SAMPLE DATE TIME MST D M Y H M	02061F TEMPERATURE DEG.C.	33003L ARSENIC TOTAL AS MG/L	48004L CADMIUM TOTAL CD MG/L	24004L CHROMIUM TOTAL CR MG/L	27004L COBALT TOTAL CO MG/L	29008L COPPER TOTAL CU MG/L	82005L LEAD TOTAL PB MG/L	25006L MANGANESE TOTAL MN MG/L
24 11 71 13 00		0.002	L.001	0.008	0.002	0.002	0.01	0.02
7 12 71 17 00	0							
26 1 72 10 30	0		L.001	0.004	0.002	0.006	0.02	0.01
9 2 72 17 00			0.001		0.010	0.003	0.01	0.12

SAMPLE DATE TIME MST D M Y H M	28004L NICKEL TOTAL NI MG/L	34003L SELENIUM TOTAL SE MG/L	30006L ZINC TOTAL ZN MG/L	80002L MERCURY TOTAL HG MG/L
24 11 71 13 00	0.002	0.005	0.007	0.0018
26 1 72 10 30	0.007	L.01		
9 2 72 17 00	0.020	0.01	0.044	0.0005

WATER QUALITY DATA

STATION 00AT05BM223C LATITUDE 50D 41M 00S LONGITUDE 112D 50M 10S

BOW RIVER AT CLUNY

SAMPLE DATE TIME MST D M Y H M	08202L OXYGEN BIOCHEMICAL DEMAND 02 MG/L	C2001L ODOUR THRESHOLD ODOUR NUMBER T.O.N	06531L PHENOLIC MATERIAL MG/L	10471L RESIDUE TOTAL MG/L	06521L OIL & GREASE O & G MG/L	36001L COLIFORM TOTAL MPN NO/100ML	36011L COLIFORM FECAL MPN NO/100ML	76900L STANDARD PLATE COUNT BACTERIAL DENSITY NO/ML
24 11 71 16 00	1.3	4	0.000	180.	1.1	70	0	8000
7 12 71 15 30	0.9	8	0.003	242.	0.7	350	0	11500
26 1 72 09 00	0.9	2	0.002	270.0	0.3	0	0	900000
9 2 72 15 30	1.1	2	0.001	260.	1.6	240	14	1200

SAMPLE DATE TIME MST D M Y H M	19101L POTASSIUM DISSOLVED K MG/L	C2041L SPECIFIC CONDUCTANCE UMHO/CM	10151L ALKALINITY PHENOL CACO3 MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10605L HARDNESS TOTAL CACO3 MG/L	16302L SULPHATE DISSOLVED SO4 MG/L	11101L SODIUM DISSOLVED NA MG/L	08101L OXYGEN DISSOLVED 02 MG/L
24 11 71 16 00	0.9		10.	170	165.	50.	6.	14.0
7 12 71 15 30	1.1			170	200.	50.	6.	12.7
26 1 72 09 00	0.9	320		140	215.0	95.0	0.5	0.7
9 2 72 15 30	1.1	330		150	155.	50.0	4.2	0.0

SAMPLE DATE TIME MST D M Y H M	07551L NITROGEN DISSOLVED AMMONIA N MG/L	10301L PH PH UNITS	17201L CHLORIDE DISSOLVED CL MG/L	09105L FLUORIDE DISSOLVED F MG/L	12103L MAGNESIUM DISSOLVED MG MG/L	07106L NITROGEN DISS.NITRATE & NITRITE N MG/L	02073L TURBIDITY TOTAL TURBIDITY UNITS	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L
24 11 71 16 00	0.8	8.4	5.	0.21		0.7	2.	0.2
7 12 71 15 30	1.3		2.	0.10		1.1	0.	0.5
26 1 72 09 00	0.4	7.5	5.0	0.20	29.0	0.9	1.0	0.5
9 2 72 15 30	0.4	8.2	16.	0.10		1.1	2.	0.7

SAMPLE DATE TIME MST D M Y H M	02061F TEMPERATURE DEG.C.	33003L ARSENIC TOTAL AS MG/L	48004L CADMIUM TOTAL CD MG/L	24004L CHROMIUM TOTAL CR MG/L	27004L COBALT TOTAL CO MG/L	29008L COPPER TOTAL CU MG/L	82005L LEAD TOTAL PB MG/L	25006L MANGANESE TOTAL MN MG/L
24 11 71 16 00		0.004	L.001	0.006	0.004	0.011	0.00	0.01
7 12 71 15 30	0							
26 1 72 09 00	0		L.001	0.004	0.004	0.008	0.02	0.01
9 2 72 15 30			0.001	0.004	0.005	0.003	0.00	0.01

SAMPLE DATE TIME MST D M Y H M	28004L NICKEL TOTAL NI MG/L	34003L SELENIUM TOTAL SE MG/L	30006L ZINC TOTAL ZN MG/L	80002L MERCURY TOTAL HG MG/L
24 11 71 16 00	0.002	0.005	0.025	0.0021
26 1 72 09 00	0.006	0.01	0.067	
9 2 72 15 30	0.005	0.01	0.023	0.0051

WATER QUALITY DATA

STATION 00AT05BL2200 LATITUDE 50D 42M 30S LONGITUDE 113D 53M 20S

SHEEP RIVER AT HWY 2

SAMPLE DATE TIME MST D M Y H M	08202L OXYGEN BIOCHEMICAL DEMAND 02 MG/L	02001L ODOUR THRESHOLD ODOUR NUMBER T.O.N	06531L PHENOLIC MATERIAL MG/L	10471L RESIDUE TOTAL MG/L	06521L OIL & GREASE O & G MG/L	36001L COLIFORM TOTAL MPN NO/100ML	36011L COLIFORM FECAL MPN NO/100ML	36900L STANDARD PLATE COUNT BACTERIAL DENSITY NO/ML
24 11 71 12 30	2.1	4	0.001	276.	1.6	25	4	23000
7 12 71 19 00	0.9	1	0.000	304.	0.9	170	11	2200
25 1 72 17 00	1.0	4	0.004	330.0	0.5	200	0	90000
8 2 72 17 00	1.5	1	0.001	314.	1.0	45	4	23500

SAMPLE DATE TIME MST D M Y H M	19101L POTASSIUM DISSOLVED K MG/L	02041L SPECIFIC CONDUCTANCE UMHO/CM	10151L ALKALINITY PHENOL CACO3 MG/L	10101L ALKALINITY TOTAL CACO3 MG/L	10605L HARDNESS TOTAL CACO3 MG/L	16302L SULPHATE DISSOLVED SO4 MG/L	11101L SODIUM DISSOLVED NA MG/L	08101L OXYGEN DISSOLVED O2 MG/L
24 11 71 12 30	1.2		10.	190	230.	70.	10.	
7 12 71 19 00	1.8			145	270.	70.	11.	11.8
25 1 72 17 00	1.2	430		185	230.0	65.0	11.5	11.0
8 2 72 17 00	1.5	360		200	180.	64.	11.	11.1

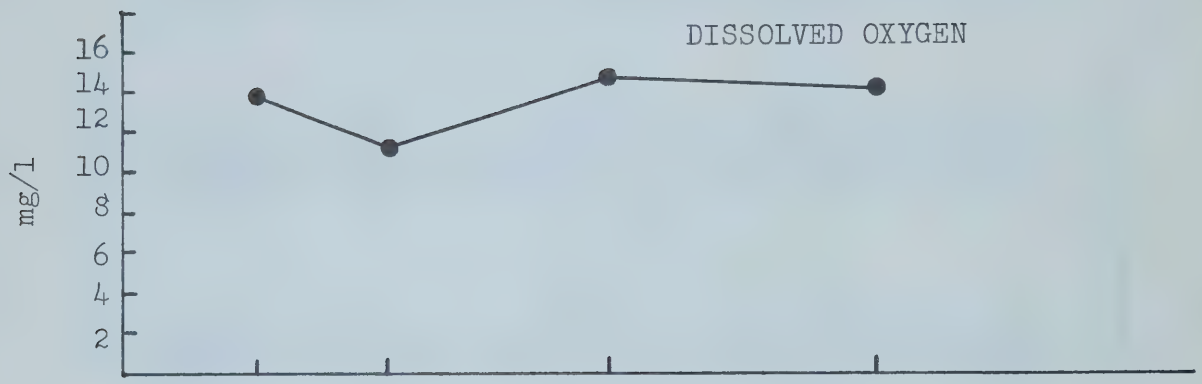
SAMPLE DATE TIME MST D M Y H M	07551L NITROGEN DISSOLVED AMMONIA N MG/L	10301L PH PH UNITS	17201L CHLORIDE DISSOLVED CL MG/L	09105L FLUORIDE DISSOLVED F MG/L	12103L MAGNESIUM DISSOLVED MG MG/L	07106L NITROGEN DISS.NITRATE & NITRITE N MG/L	02073L TURBIDITY TOTAL TURBIDITY UNITS	15406L PHOSPHOROUS TOTAL PHOSPHATE P MG/L
24 11 71 12 30	0.1	8.4	3.	0.06		0.1	2.	0.0
7 12 71 19 00	0.2	8.3	5.	0.15		0.0	0.	0.4
25 1 72 17 00	0.3	7.9	7.0	0.25	38.0	0.6	0.0	0.3
8 2 72 17 00	0.4	7.9	18.	0.20	15.	0.2	1.	0.2

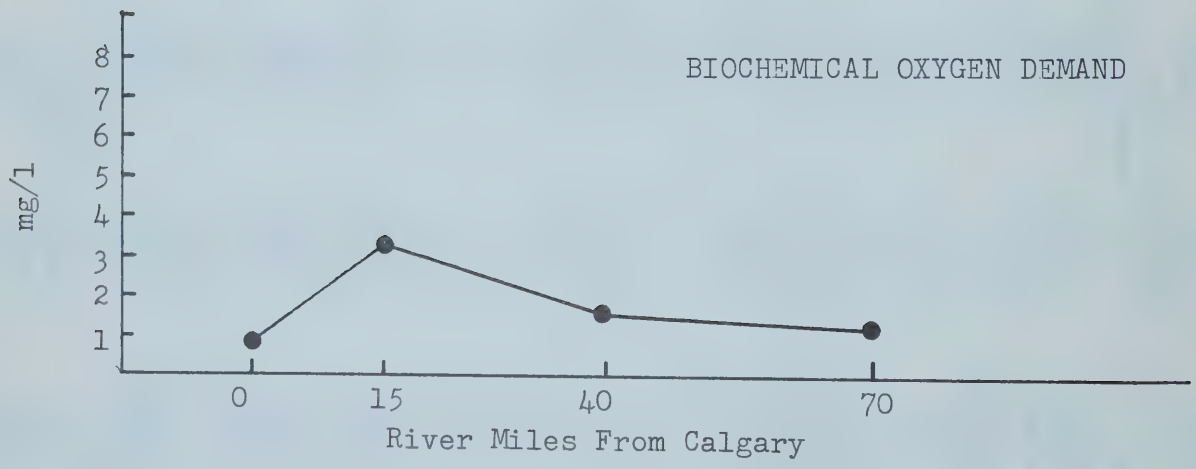
SAMPLE DATE TIME MST D M Y H M	02061F TEMPERATURE DEG.C.	33003L ARSENIC TOTAL AS MG/L	48004L CADMIUM TOTAL CD MG/L	24004L CHROMIUM TOTAL CR MG/L	27004L COBALT TOTAL CO MG/L	29008L COPPER TOTAL CU MG/L	82005L LEAD TOTAL PB MG/L	25006L MANGANESE TOTAL MN MG/L
24 11 71 12 30		0.004	0.001	0.004	0.004	0.017	0.02	0.01
7 12 71 19 00	0							
25 1 72 17 00	0		L.001	0.004	0.004	0.017	0.02	0.01
8 2 72 17 00			0.001	0.004	0.005	0.005	0.01	0.01

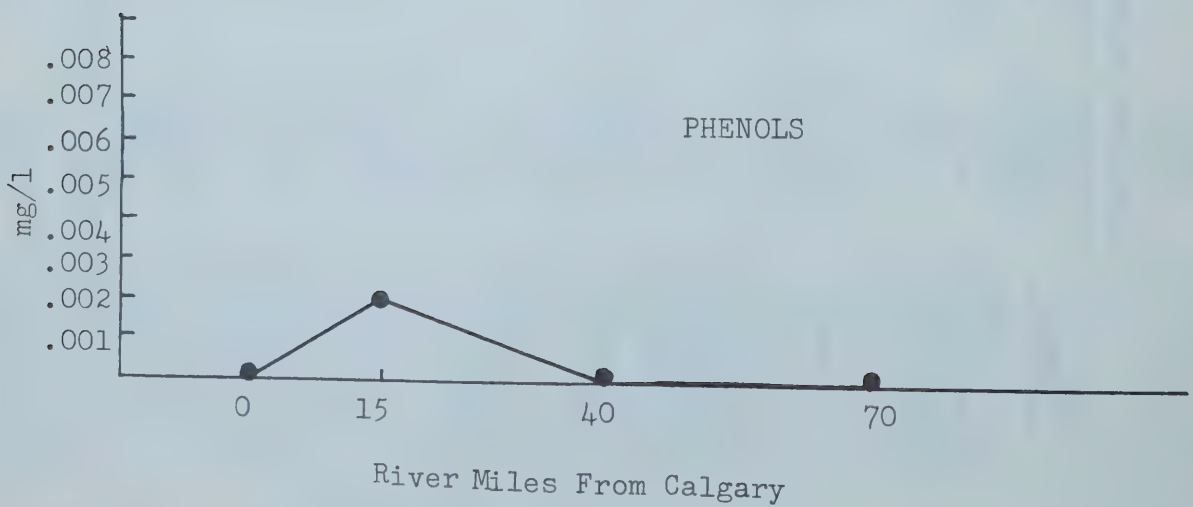
SAMPLE DATE TIME MST D M Y H M	28004L NICKEL TOTAL NI MG/L	34003L SELENIUM TOTAL SE MG/L	30006L ZINC TOTAL ZN MG/L	80002L MERCURY TOTAL HG MG/L
24 11 71 12 30	0.005	C.C1C	0.024	
25 1 72 17 00	0.011	0.01	0.050	0.0011
8 2 72 17 00		L.C1	0.033	0.0005

BOW RIVER SAMPLING RESULTS

Nov. 23 - 24, 1971

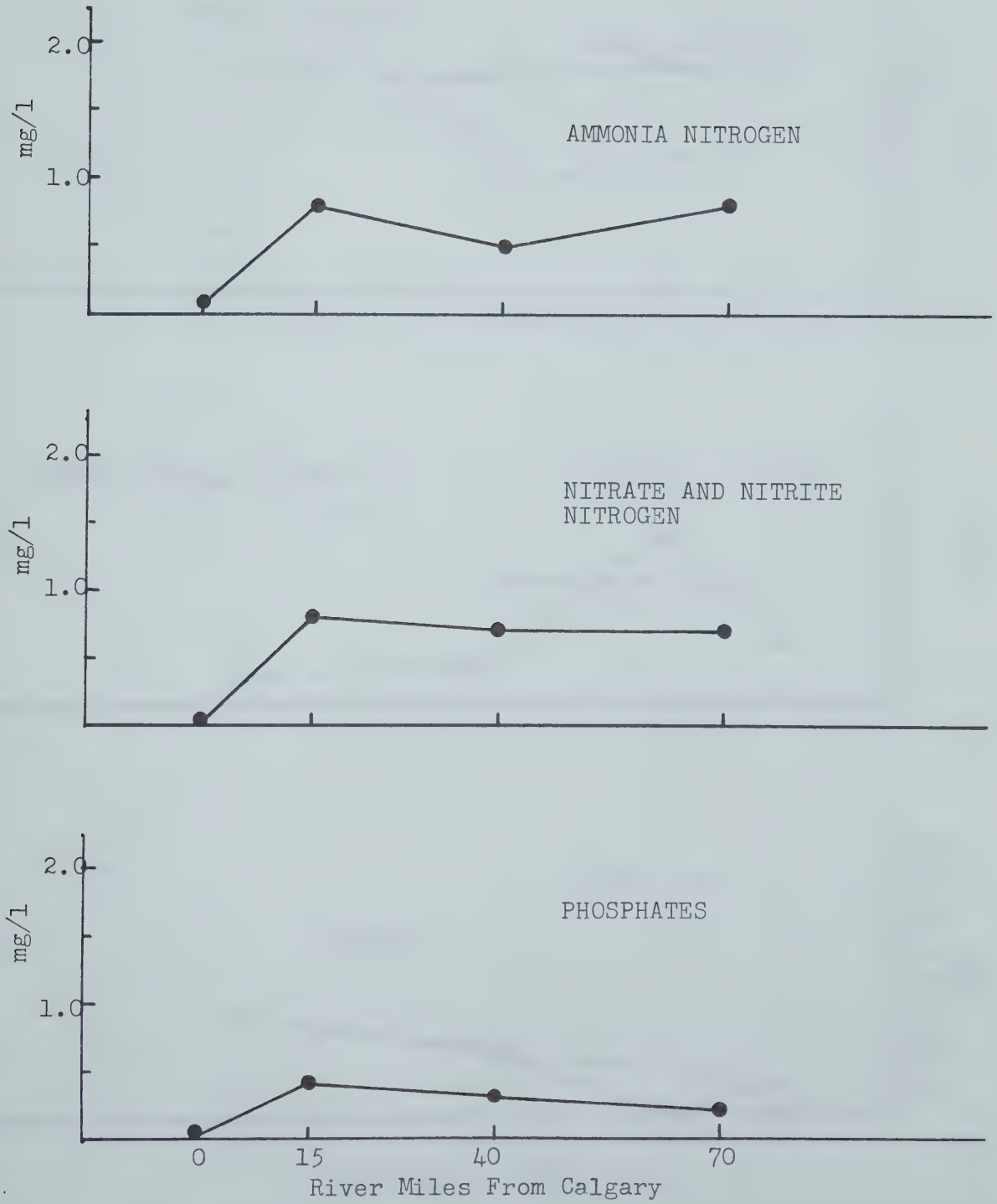






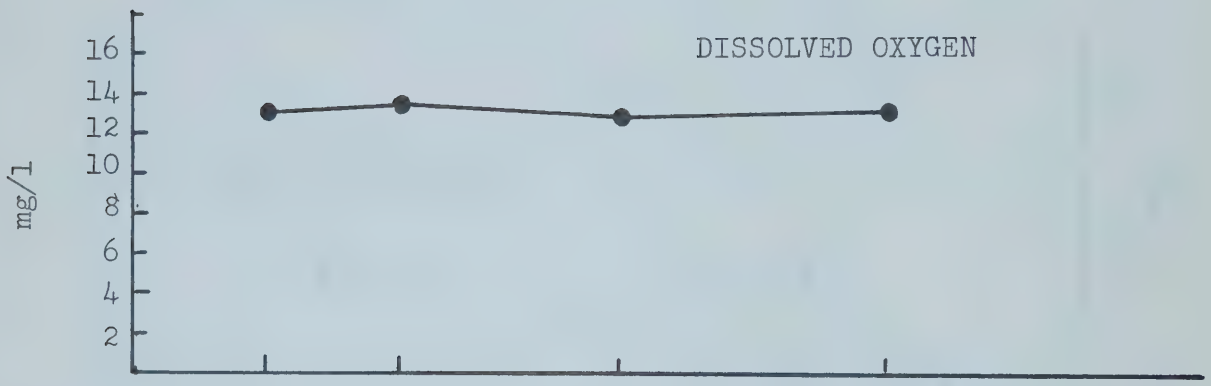
BOW RIVER SAMPLING RESULTS

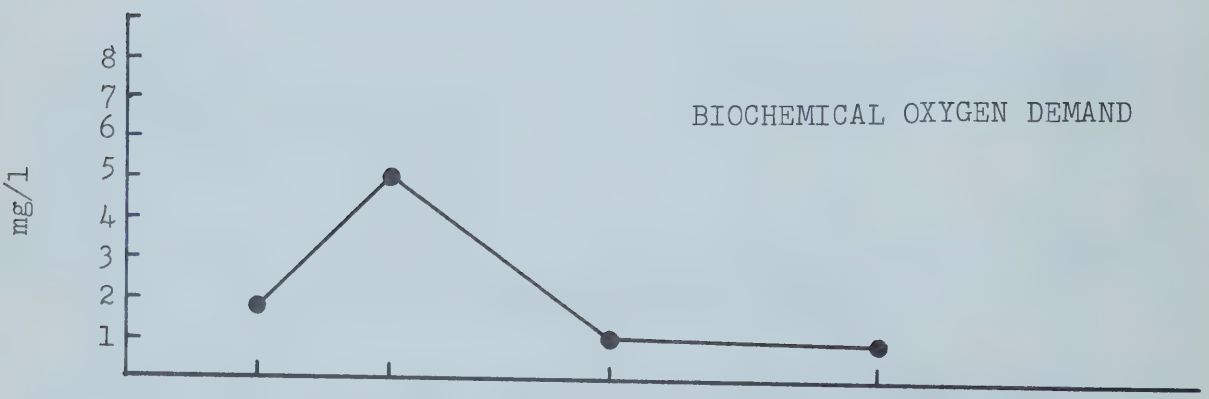
Nov. 23 - 24, 1971

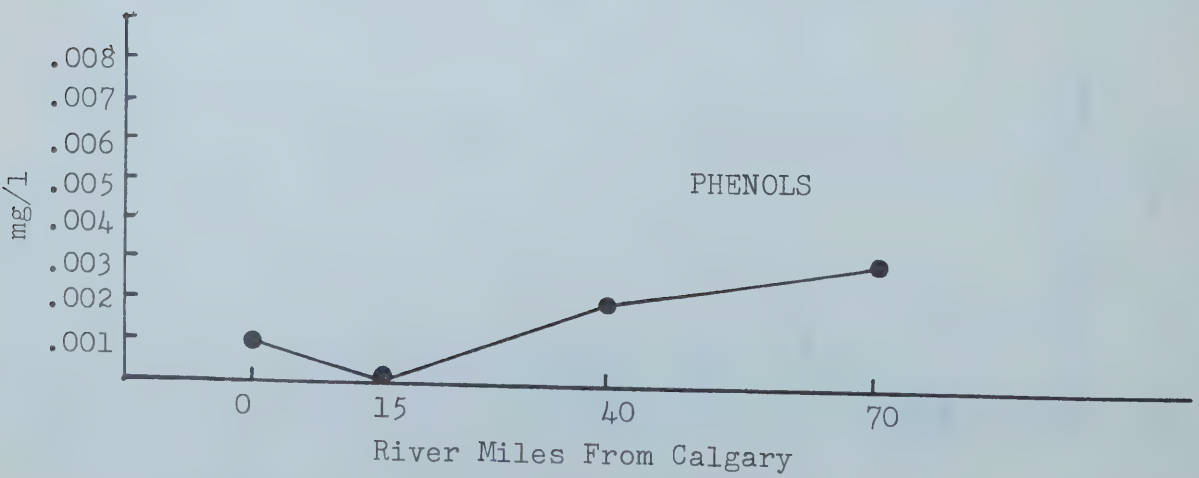


BOW RIVER SAMPLING RESULTS

Dec. 7, 1971

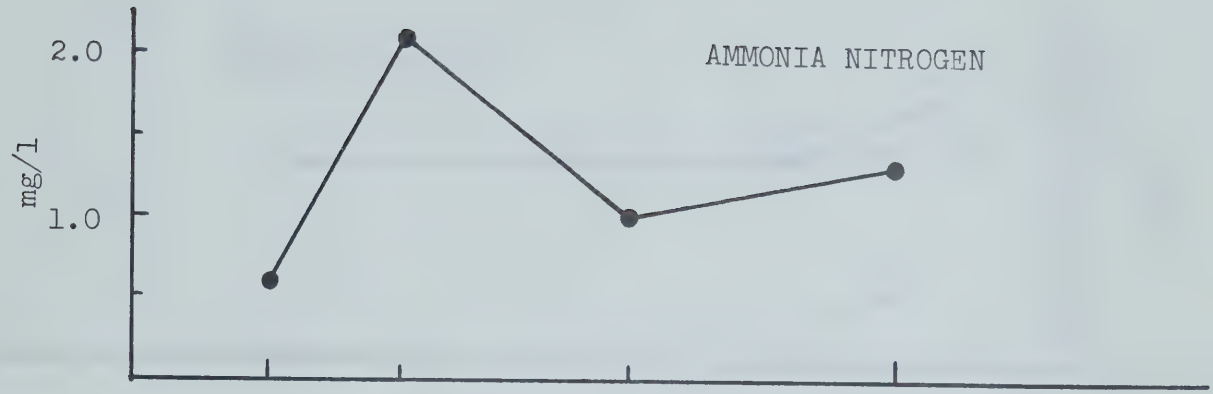


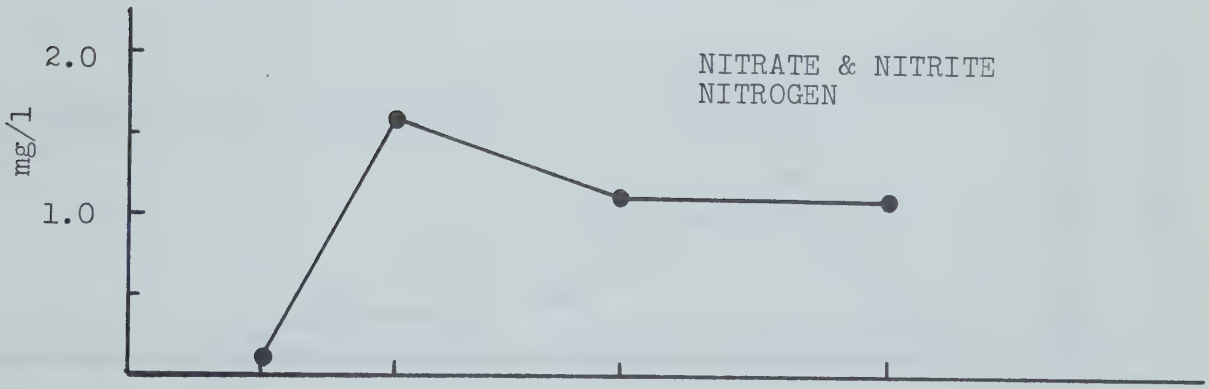


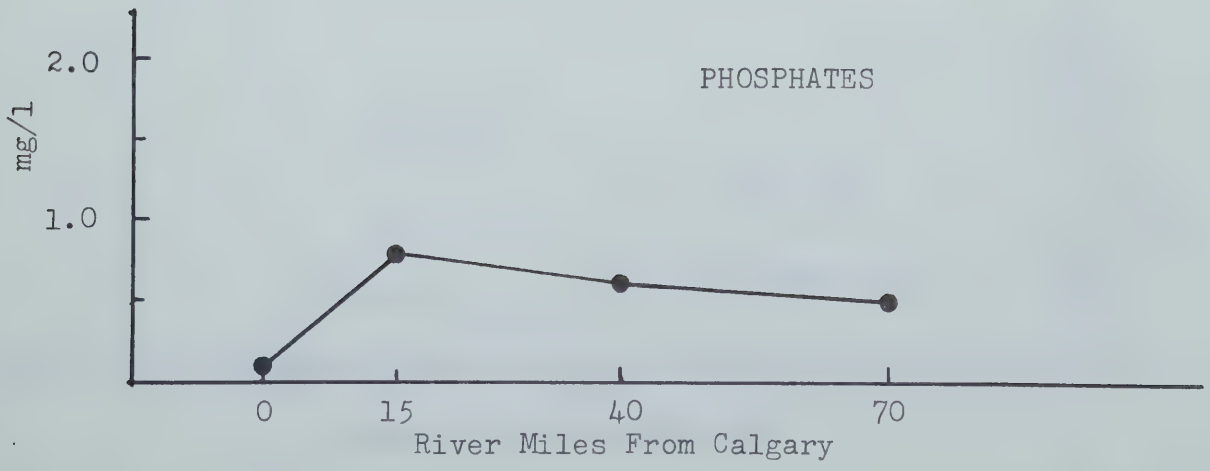


BOW RIVER SAMPLING RESULTS

Dec. 7, 1971

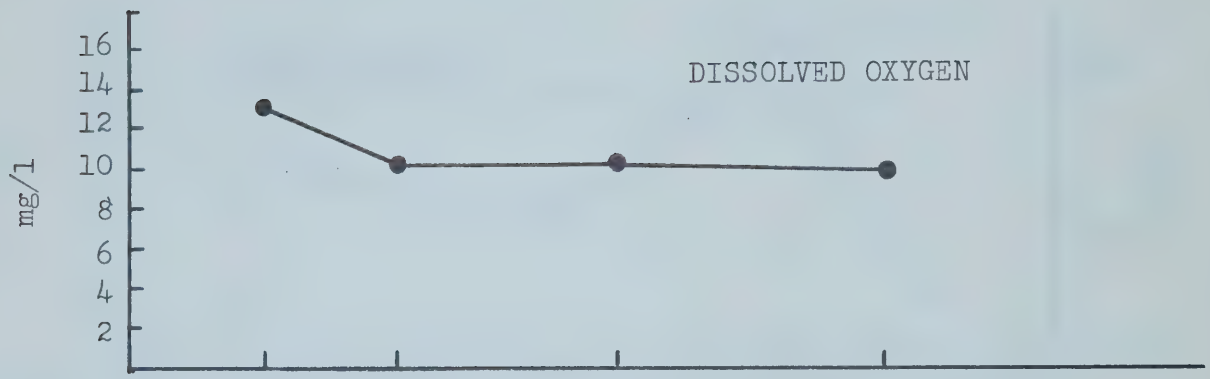


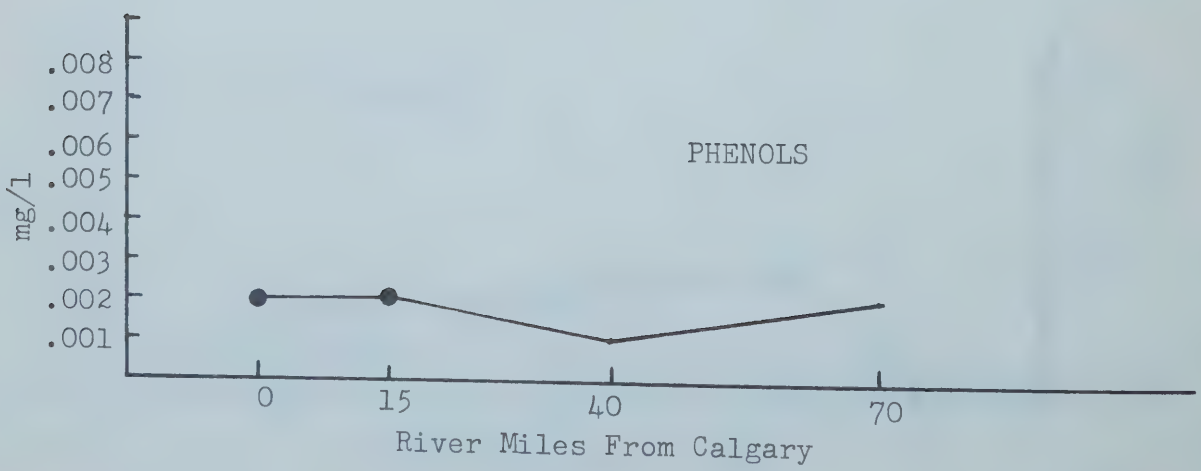




BOW RIVER SAMPLING RESULTS

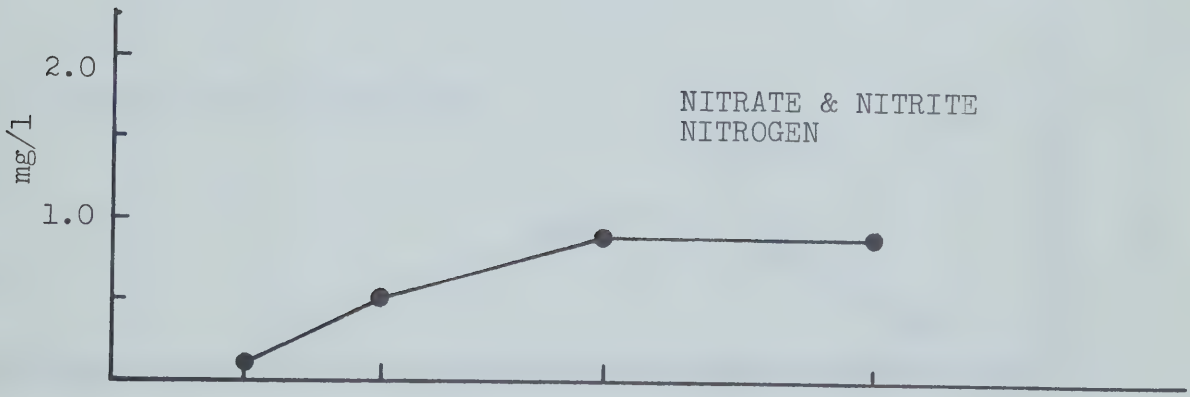
Jan. 25 - 26, 1972

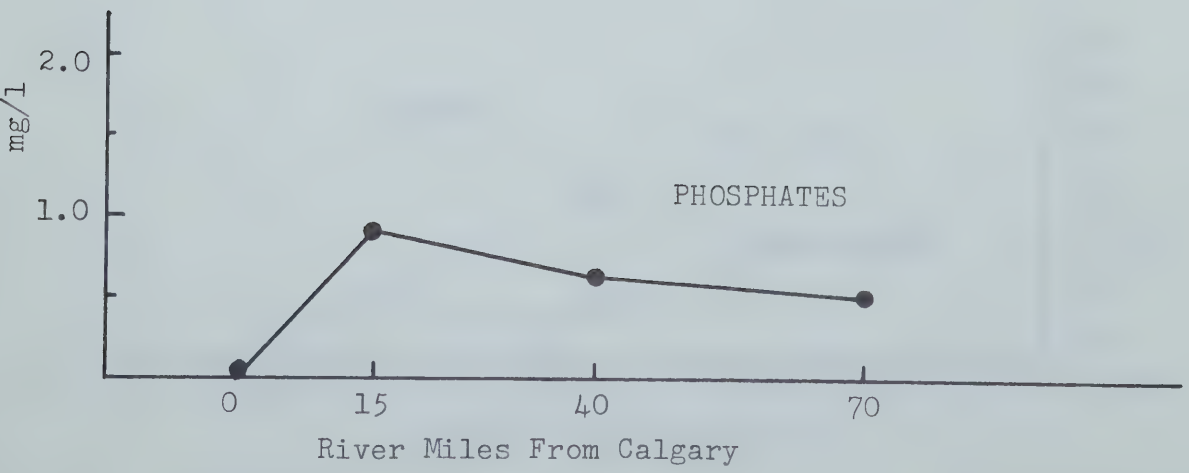




BOW RIVER SAMPLING RESULTS

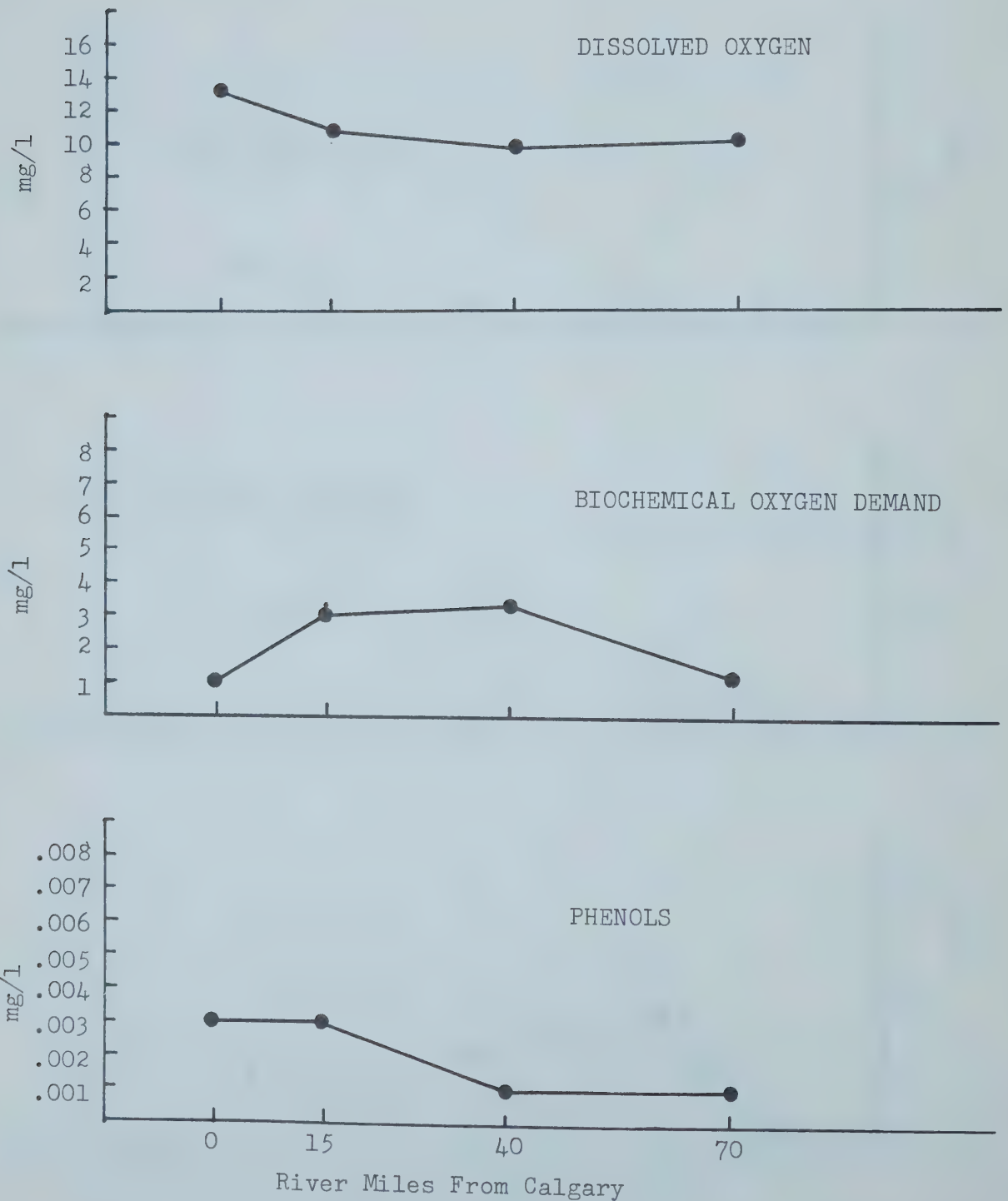
Jan. 25 - 26, 1972





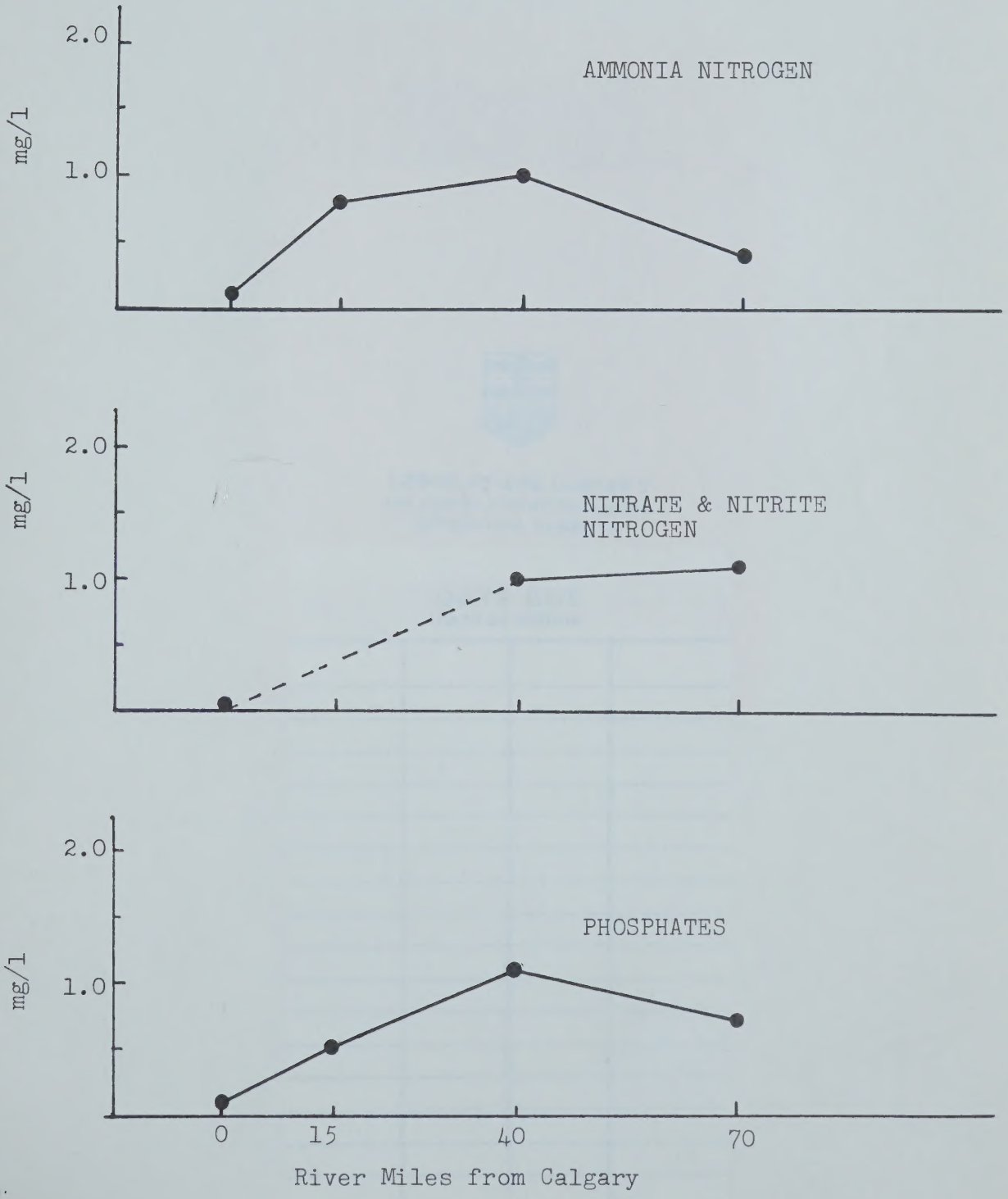
BOW RIVER SAMPLING RESULTS

Feb. 8 - 10, 1972



BOW RIVER SAMPLING RESULTS

Feb. 8 - 10, 1972



LEGISLATURE LIBRARY
216 LEGISLATURE BUILDING
EDMONTON, ALBERTA

DATE DUE
DATE DE RETOUR

LOWE-MARTIN No. 1137